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Proceedings of the

X INTERNATIONAL CONGRESS OF GENETICS

Comptes rendus du

Xe CONGRÈS INTERNATIONAL DE GÉNÉTIQUE

August 20–27, 1958
McGILL UNIVERSITY, MONTREAL

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Volume II: Abstracts

University of Toronto Press, Toronto, Ontario, Canada
1958

BLACK GOLD

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ADDITIONAL CROSS-REFERENCES

1057872

Boldea, E. *See* Priadcencu, Al., *et al.*
Camargo, M. L. Pires de. *See* Cunha, A. B. da, *et al.*
Caspari, Sarah B. *See* Whiting, P. W.
Cole, D. *See* Cameron, J. W.
Dun, R. B. *See* Fraser, A. S.
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Yagyu, P. *See* Burnham, C. R., *et al.*

MILKMAN, ROGER. The Genetic Basis of Natural Variation. *Department of Zoology, University of Michigan, Ann Arbor, Mich., U.S.A.*

A rare deviant phenotype may be due to a single rare gene or to a rare combination of not uncommon genes. The latter case, being harder to study, is usually ignored, but Lerner and others have emphasized its possible importance.

A number of genes which act together to cause defects in the posterior crossvein of *Drosophila melanogaster* were assembled from a wild strain, first by selecting successfully for phenocopy susceptibility, as Waddington had done, and then by selecting for increased expression of the *crossveinless* phenotype. The analysis of the true-breeding stock ultimately obtained is presented.

There are at least 5 additively acting *crossveinless* polygenes scattered over the 3 major chromosomes. One is at about 1–57, another at 3–72 (identical with *detached*). Other common properties of these genes are similar interactions with other genes, similar temperature effects, and enhancement of phenocopy susceptibility with respect to crossvein defects.

Since similar complexes causing similar phenotypes have been isolated in various parts of the world, and since *crossveinless* flies seem to occur with a frequency of about 1 in 1000 in the wild, we may regard these genes as widespread and individually common.

The possible significance of such genetic systems in evolution is discussed.

ABBOTT, URSULA K., and VIGFUS S. ASMUNDSON. Further Studies with Scaleless—An Inherited Ectodermal Defect in the Fowl: II, Heat Production and Respiratory Quotient. *Poultry Husbandry Department, University of California, Davis, Calif., U.S.A.*

The inheritance and phenotypic expression of scaleless have been described by Abbott and Asmundson (1957). The original carrier New Hampshire stock was outcrossed in 1956 to 4 distinct breeds of chicken: Jungle Fowl, Cornish, Barred Plymouth Rock, and Single Comb White Leghorn. F_2 progenies from each cross, segregating for scaleless, were reared in the following year. An equal number of scaleless and normal progeny of similar breeding from each cross and from some relatively non-inbred New Hampshire stock were subjected either to hypothermic stress at one day of age (prolonged shock) to the LD50 point for scaleless or to timed periods of cold (intermittent shock). The former method gave most consistent results; accordingly, most of the results presented are based on this procedure. An equal number of scaleless and normal birds were maintained as controls. Survivors and controls were tested when 5–9 weeks old in specially designed chick respiration units, capable of housing 7 birds. In each trial 6 units containing an equal number of scaleless and normal birds of similar sex and breeding were used.

Heat production and respiratory quotients of scaleless and normal shocked and unshocked birds are presented. Scaleless and normal differed significantly while stressed and unstressed birds showed slight differences. Values for different crosses are given. The respiratory quotients of scaleless and normal birds also differed, scaleless being lower than normals. Some fasted-fed comparisons on the same birds indicated that heat production of scaleless birds tended to increase following a 24-hour fast in contrast to normals. With increasing weight the heat production of scaleless decreased while that of normals increased. Scaleless birds were more variable in heat production and in respiratory quotient than normal birds. The need for increased heat production to maintain normal body temperature undoubtedly accounts, at least in part, for the significantly lower egg production of scaleless than normal sisters. The higher heat output may also explain differences in the thyroid gland which is larger per unit of body weight in scaleless than in normal birds.

ADAMS, ELIJAH. *See* SCHWINCK, ILSE.

ADATI, SYÔZÔ. Cytogenetics of Japanese Wild Forage *Miscanthus* Species. *Faculty of Agriculture, Mie University, Tu, Mie-Ken, Japan.*

Miscanthus species are grown widely in the eastern parts of Asia, especially in Japan. *M. sinensis* is the most common species and has been used as forage grass all over Japan from ancient times though it is poor in nutritive substance. Its varieties, *M. sinensis* var. *condensatus* and *M. sacchariflorus,* which grow in humid soil, proved to be rich in protein and fat and were also found to be palatable on the basis of chemical analyses and digestive experiments with rabbits. Intergeneric and interspecific hybridizations have been carried out. The plants are propagated by seed or vegetatively by division or even by cutting as, e.g., *M. sacchariflorus*. The genus *Miscanthus* includes 6 species in Japan.

The basic chromosome number in *Miscanthus* is 19 which is the highest basic chromosome number in Gramineae. I have found polyploid series of 2, 3, 4, 5 and 6x, and their karyotype analysis has been carried out.

Diploid species ($2n = 38$, *M. sinensis, M. floridulus* as *M. japonicus, M. tinctorius* and *M. oligostachyus*) have a very similar karyotype with one pair of long chromosones with intercalary trabant (*cs*–chromosome). Autotriploid M. *sinensis* var. *condensatus* ($2n = 57$) has 3 *cs*–chromosomes and many heteroploid plants have been raised when pollinated by diploid plants of which chromosome numbers ranged from 38 to 46. Tri-, tetra- and penta-ploid plants in *M. socchariflorus* were found. The tetraploid plants ($2n = 76$) are common and have one pair of *cs*-chromosomes, therefore I suppose them to be allotetraploids. There are two kinds of triploid plants ($2n = 57$), one is sterile with 2 *cs*-chromosomes, while the other (*M. sacchariflorus* Bentham var. *brevibarbis* (Honda) Adati) is sterile with one *cs*-chromosome. Pentaploid plants ($2n = 95$, *M. sacchariflorus* form. *latifolius* Adati f. nov.) are very vigorous and have 4 *cs*-chromosomes. *M. intermedius* is autohexaploid ($2n = 114$) with 6 *cs*-chromosomes and grows in the northern parts of Japan.

AHUJA, Y. R. An Eye-Hair Human Mosaic. *Department of Genetics, University of California, Berkeley, Calif., U.S.A.*

This is a report of the rare case of a girl 20 years old, who shows partial bilateral asymmetry of eye and hair color. The color of her left iris is predominantly hazel with a brown pigment spot, while her right iris is predominantly blue with some yellow pigment spots. Most of the hair on her head is brown but there are two patches, one large and one small, of very light yellow hair on the right side. She does not appear to show asymmetry with regard to other characters. Her mother has dark brown eyes and hair. Her father has pale blue eyes and had blond hair in his youth but is bald now. Thus it is apparent that the eye and hair color predominant on the left side of the mosaic approximate those of her mother while the colors on the right side are more similar to those of her father.

In attempting to explain the causes of this mosaic condition it should be borne in mind that eye and hair color are not inherited in simple monogenic fashion. We may, however, assume that the dark or brown color of both the eyes and hair is partially dominant over blue eyes and blond hair respectively. Further, there is some evidence to the effect that degree of pigmentation of eye and hair is correlated.

The origin of bilateral asymmetry of the eye and hair color could be related, among others, to: (*a*) somatic mutations, (*b*) abnormal distribution of chromosomes during development, (*c*) somatic deletion, (*d*) somatic crossing-over. These mechanisms will be discussed.

The mosaic condition known as heterochromidia iridis and white forelock have both been reported to be inherited dominantly. However, it is not likely that the present mosaic condition will be transmitted.

AKSEL, RUSTEM. *See* JOHNSON, L. P. V.

ALEXANDER, DENTON E. Genetic Induction of Autotetraploidy in Maize. *University of Illinois, Urbana, Ill., U.S.A.*

Maize plants homozygous for the recessive gene elongate (*el*) produce reduced and unreduced megaspores. Microsporogenesis is normal.

Agronomically useful inbred lines were outcrossed to *el/el* stocks, and the F_1's backcrossed to the parent inbred lines. The backcross progenies were self-pollinated, and the segregates subsequently crossed with established autotetraploid males. The *el/el* segregates bore triploid and tetraploid zygotes; the ± segregates produced triploid zygotes only.

Autotetraploids produced in this way were planted in isolation and permitted to interpollinate.

Open-pollinated diploid varieties are currently being converted to the tetraploid level using isolated crossing block techniques. The genetic diversity of the new tetraploid population should be almost as great as that which exists in the diploid population.

The basic object of the work in an idealistic sense is to transform a diploid species with all its genetic diversity to a tetraploid species.

ALEXANDER, MARY L. The Relationship of Radiations and Environmental Changes in Oxygen Concentrations for Biological Damage in the Immature Germ Cells of *Drosophila virilis. Biology Department, University of Texas, M. D. Anderson Hospital, Houston, Tex., U.S.A.*

The post-meiotic cells of spermatogenesis of *Drosophila virilis* show differences in the amount of translocations and dominant lethals induced from radiation treatment. Meiotic and spermatogonial cells were different in that qualitative as well as quantitative differences in radiobiological damage have been found. The post-meiotic cells, which include mature non-motile sperm and several stages of spermatids, varied in sensitivity to X-rays, gamma rays and fast neutrons. With these radiations, the biological damage was consistently higher in spermatids than in mature sperm when oxygen was present at the time of treatment. The spermatid cells differ from mature sperm in that the same environmental concentration of oxygen, with radiation treatment, enhanced biological damage to a different extent. Oxygen concentrations over 20% (air) were not effective for increasing the damage in sperm cells; whereas, with spermatids, atmospheres of pure oxygen continued to increase the biological damage over the values obtained for air.

A slight but definite enhancement was obtained with oxygen with fast neutrons in the various types of immature germ cells. The amount of the increase in biological damage was not the same in all types of cells, indicating that the effectiveness of oxygen in the cells was not equal since all cells were treated in pure oxygen. Although oxygen enhances biological damage with neutrons, greater increases were evident with 200 Kv X-rays. The sensitivity of spermatids to oxygen was shown by increases in translocations with small changes in the environmental oxygen concentrations.

The lethal damage in the meiotic and spermatogonial cells was influenced by increases in oxygen concentrations with both X-ray and fast neutrons. With radiation treatment, lethal damage in germ cells in the meiotic and spermatogonial stages may result from cell degeneration in the testes of the males or, secondly, from injury which survives these divisions and acts as a lethal in some later division.

Differences in the lethal damage induced in spermatids by gamma rays in pure oxygen were obtained by varying the dose rates of the radiation. However, mature sperm showed no differences in lethal damage with fast, slow or fractionated doses of gamma rays when treatments were made in an atmosphere of nitrogen. (Work supported by Contract No. AT-(40–1)-1828 between the United States Atomic Energy Commission and the University of Texas, M. D. Anderson Hospital.)

ALIKHANIAN, S. I., and T. S. ILJINA. Mutagenic Effect of Actinophage. *Antibiotics Research Institute, Moscow, U.S.S.R.*

In the plating of the phagolysate of *Actinomyces olivaceus*, N-6, obtained after its treatment with actinophage no. I in submerged conditions (in shake flasks) a high percentage of mutations is discovered. The frequency of morphological mutations reached 98%.

The typical colonies of strain N-6, without phage treatment, are dark grey and well sporulating. After phage treatment many mutants were discovered including white, light grey, light yellow, lemon yellow, film-like, and bacterial colony like mutants. Of great interest are biochemical mutations obtained under the action of actinophage. The frequency of appearance of biochemical mutations reaches 3.15% and greatly excels the ordinary frequency of biochemical mutations appearing under the action of other mutagenic factors, e.g., UV-rays.

In the course of studying the mutagenic action of a number of other actinophages belonging to the polyphage group it was discovered that some of the actinophages studied have their own "mutational spectrum" both in the frequency and in the character of mutations induced by them.

The influence of host culture (on which the phage multiplied itself) upon the "mutational spectrum" of the actinophage was studied. The mutations induced by two variants of one and the same phage were shown to be quite distinct in their character. For example, the actinophage grown on *Streptomyces griseus*, strain II (*A. globisporus* streptomycini after Krasilnikov), induces white, light yellow and lemon yellow mutations whereas the same phage grown on *Actinomyces olivaceus*, strain N-6, induces black and brown mutations. The influence of the host culture upon the mutagenic properties of actinophage gives us grounds to compare the phenomenon mentioned with the transduction phenomenon in bacteria.

ALIKHANIAN, S. I., and T. S. ILJINA. Recombinations in *Actinomyces Rimosus. Antibiotics Research Institute, Moscow, U.S.S.R.*

The discovery of recombinations in various species of bacteria on the one hand, and parasexual process in fungi on the other, allows one to assume that certain forms of sexual process exist in *Actinomycetes*, too, the latter being intermediate organisms between the two groups of organisms mentioned above. The breeding of hybrid forms of *Actinomycetes* is the more important as the majority of them are organisms producing antibiotics and are used in human practice.

By using the method of mixed growth of biochemical mutants, recombinant forms of *Actinomyces rimosus*, a terramycin-producing actinomycete, are obtained experimentally. Recombinant forms both inside one and the same strains and between different strains of *Actinomyces rimosus* were shown to appear.

Various combinations of biochemical mutants are characterized by various frequency of appearance of recombinant forms. The frequency of recombinations within one given combination depends on the conditions of mixed growth of parent forms. Conditions permitting one to increase the frequency of recombinations up to 1,000 times are found. On the other hand, it is shown that in a liquid medium (both in shaking flasks and in stationary conditions) recombinations do not appear at all.

Appearance of several (2–3) types of prototroph forms, differing from one another both in morphological characters and in antibiotic activity, is discovered in some combinations of biochemical mutants. The proportion between different types of prototrophs appearing in a given combination changes with a change in conditions of parent forms growth.

Comparative studies of antibiotic activity of the recombinants, their parent forms (biochemical mutants), as well as the original strains (strains out of which the biochemical mutants were isolated), were carried out.

The antibiotic activity of the recombinants was shown to excel many times that of the parent forms. The activity of some of them reaches the activity of the original strains, or even excels it to a certain degree.

Essential differences between recombinants were discovered in the course of studying their stability. Some recombinants are absolutely stable and never segregate parent forms. Other recombinants in a number of generations always segregate biochemically deficient forms which are identical biochemically to one of the parent forms. Segregants corresponding to the other parent form were not discovered.

ALLEN, FRED H., JR., PATRICIA A. CORCORAN, and LOUIS K. DIAMOND. Blood Groups of Eastern American Indians. *Blood Grouping Laboratory of Boston, Boston, Mass., U.S.A.*

Preliminary tests, done on 103 members of the Penobscot Tribe in Old Town, Maine, show blood-group frequencies quite similar to those that have been found in Indians of western North and South America, when allowance is made for some White admixture. In the preliminary tests, the following reagents were used:

anti-A, -B, -A_1. -H, -C, -c, -D, -E, -e, -C^w, -E^w, -M, -N, -M^g, -S, -Vw, -K, -Kp^a, Fy^a, -Jk^a, -P, -Le^a, -Le^b, Lu^a, -Wr^a, -Be^a, -Vel, and -Di^a.

As expected from the similarity to Western Indians of the other blood groups, the Diego (Di^a) factor was found in some of those tested. As expected from the known white admixture, some K-positive and Kp^a-positive individuals were found, indicating that linkage counts between Diego and Kell will probably be possible after further testing. Lu^a-positive was frequent enough to make it quite certain that further work will allow linkage counts between Diego and Lutheran. The greater frequency of Rh-negative than is found in groups previously studied aids in the identification of the rarer Rh genes. There are advantages in the racial admixture which appear to outweigh the possible disadvantages.

Work is in progress, and the lastest findings will be presented, particularly the linkage studies on the Diego blood groups.

ALLEN, GORDON. *See* PERLIN, SEYMOUR.

ALLISON, A. C. Metabolic Polymorphisms in Mammals. *National Institute for Medical Research, London, England.*

Recent studies have brought to light a number of genetically controlled differences in the proteins taken from different animals of the same species. These are of interest for three main reasons: they provide information about the way in which gene products can differ; they are responsible for some powerful selective effects that have interesting consequences in population genetics; and since the alleles controlling the characters are common in populations, they provide a number of marker loci for linkage studies.

These broad groups of metabolic polymorphisms can be distinguished. In one group each allele controls the formation of a distinct product and in the heterozygote both products are present. This is found, for example, in most of the haemoglobin types in man and other mammals, and in the lactoglobulin types in cattle. (Some of the human haemoglobin types differ by only a single amino-acid residue in each molecule.) Modifier genes are known to control the proportions of the two products in heterozygotes, in the extreme case suppressing one product altogether and thereby bringing about dominance modification. In the second group the two alleles produce distinct products, but the products in heterozygotes are intermediate. This seems to be true, for example, of some blood group genes and the human haptoglobins. Incidentally, it seems difficult to reconcile this finding with the template hypothesis of protein synthesis in its original form. Again, modifier genes are known which alter the products in the heterozygotes so that they are indistinguishable from those in one of the homozygotes, thereby bringing about dominance modification. In the third group the alleles control the formation of the same product but produce different amounts of it. This is true, for example, of the enzymes atropine esterase in rabbits and catalase in dog erythrocytes. Intermediate amounts of the product occur in heterozygotes, and this can also be enhanced or suppressed by modifiers until the amount of the product corresponds to that in one of the homozygotes. This is again an example of dominance modification. Other cases are on record where the primary biochemical differences are not yet known, e.g., the genetically controlled differences in sodium and potassium concentration in sheep erythrocytes.

ALTENBURG, EDGAR. *See* ALTENBURG, L. S.

ALTENBURG, L. S., and EDGAR ALTENBURG. The Induction of Visible Mutations at Selected Loci by Alkylating Agents. *Rice Institute, Houston, Texas, U.S.A.*

Using Muller's "Maxy" stock heterozygous for 13 recessive visibles in the X-chromosome, a preliminary study of the production of visible mutations at these loci by phenylalanine mustard and di-methyl myleran has been undertaken. A 10^{-2} M suspension of each agent was injected intra-abdominally into young males, and their F_1 daughters were examined for visibles of all kinds. The lethal rate was obtained for comparison. Among 24,000 daughters of 257 mustard-treated males, 3 heritable visible mutations (*f*, *g*, and *w*) were found, and in addition there were 5 visibles associated with lethals, giving an average of 1 visible in 3,000 F_1 females. In the myleran-treated series from 142 treated males no heritable visibles were produced, but there were 7 visibles associated with lethals among 17,000 daughters, or a rate of 1 visible in 3,400 females. Among the controls 2 heritable visibles (*f*, *g*) were found in 45,000, or 1 in 22,500 females. The lethal mutation rate from the mustard series was $1.2 \pm 0.2\%$, and for the myleran series it was $2.0 \pm 0.3\%$.

All F_1 females were examined for mosaics for Maxy or other visible traits. In each of the two series of treated males an average of 1 mosaic for a Maxy trait in about 400 F_1 females was found. That many of these mosaics were gynanders seems likely although not many showed sex gynandromorphism. A rate of only 1 mosaic in 1,700 F_1 females was found in the control series. In the treated series only about one-sixth of the mosaics had heritable Maxy traits (a smaller proportion in the controls). A ratio of 1 complete Maxy visible to about 40 lethals was found in the treated series. If heritable traits in the mosaics are added to the complete visibles, the mutation rate for Maxy visibles in the mustard series becomes 1 in 1,200 F_1 females and in the myleran series 1 in 900 F_1 females; or a ratio of less than 1 Maxy visible to 10 lethals. (This work has been supported by a grant received for work of Edgar Altenburg and associates from the National Institute of Health, United States Public Health Service.)

ANDERS, FRITZ. On Sex Determination of *Gammarus pulex* L. *Zoologisches Institut der Universität des Saarlandes, Saarbrücken, Germany.*

Former investigations have shown that some autosomatic alleles of *Gammarus pulex* L., which cause red or reddish brown pigmentation of the integument, may cause a relative male-determining effect too, and that some combinations of these alleles may influence sex sufficiently to produce all or at least a majority of males (Anders, Vererbungsl. *88*: 291–332). In recent investigations it has been shown that the sex of *G. pulex* is determined by a large number of relative sex-determiners, which are distributed more or less equally over all the autosomes. Heterochromosomes were found neither in cytologic nor in genetic studies. Environmental factors have no perceptible influence on the sex-ratio.

ANDERSEN, A. C., and FRED T. SULTZ. A Developmental Cataract in the Dog. *School of Veterinary Medicine, University of California, Davis, Calif., U.S.A.*

Out of 1,129 purebred beagles observed 1 male showed complete bilateral cataract when 5 months of age. Matings with 5 normal dams produced 19 offspring with complete bilateral cataract, 2 with partial bilateral cataract, 1 nearly normal, and 3 normals. Puppies were sacrificed for gross histological study between 41 and 60 days of age. In all 3 outstanding defects were observed: microphthalmia, retinal folds, and lens opacity. This form of cataract seemed best explained as a defect in the development of the secondary lens fibers apparently resulting from incomplete lens capsule continuity. Neither sex linkage nor an autosomal recessive was indicated. On the assumption of a dominant mutation, the probability of this large a deviation (21:4) in either direction from the expected ratio is 0.0009.

ANDERSON, RUTH S. *See* HUESTIS, R. R.

ARMSTRONG, J. M., and M. HATTERSLEY-SMITH. Polyspory in an Amphidiploid of *Triticum-Agropyron* Hybrids. *Forage Crops Division, Central Experimental Farm, Ottawa, Canada.*

An amphidiploid line in the F_9 generation tracing to the cross *Triticum turgidum* × *Agropyron intermedium* was found to contain plants which at meiosis showed a spindle abnormality. In plants carrying the abnormal gene over 50% of the microsporocytes contained five to eight microspores instead of the normal four. The occurrence of microspores with two nuclei was also common and was more prevalent in tetrads than in hexads to octads. Meiosis was found to be regular up to metaphase II. At this time a secondary spindle was formed and the chromosomes divided and moved to the poles of primary or secondary spindles. The number of chromosomes on secondary spindles ranged from three to one-half the complement of 32–35. After telophase II wall formation was usually initiated enclosing the resulting nuclei; where walls failed to form microspores were two-nucleate. The result of this abnormal gene was to bring about almost complete sterility in the affected plants.

ARNASON, J. T. *See* WAKONIG, RESA.

ARNOLD, C. G. *See* SCHWEMMLE, JULIUS, *et al.*

AR-RUSHDI, ABBAS H. The Polygenic Basis of Sex-Ratio in *Tigriopus. University College of Arts and Sciences, Baghdad, Iraq, and Scripps Institution of Oceanography, University of California, U.S.A.*

In the tide-pool copepod *Tigriopus*, extensive data derived from individual brood-sacs corroborated previous reports on natural populations revealing a very striking deviation from a 1:1 sex-ratio. Preponderance of males being the observed condition in the majority of families.

Starting with a "randomized" parental population with 70% males, between-family selection was carried out for high and low-female lines. Against a calculated inbreeding coefficient of 0.7460, it has been possible to maintain lines in which the original sex-ratio was shifted to as high as 80% and as low as 0.5% females. Crosses among high-female lines and between high and low-female lines were also made. Inasmuch as mortality has been relatively low, and at that independent of sex-ratio, and in view of the absence of cytologically detectable chromosomal mechanisms for sex determination, data obtained indicate that in *Tigriopus* sex is determined by a system of polygenes and that the heritability of the trait appears to be relatively high.

With the genetic mechanism of sex-determination hitherto revealed, and with the drastic fluctuations in population size observed in nature, it is concluded that drift to extreme sex ratios should be of frequent occurrence; that under the austere conditions often prevailing in the tide-pools, populations with high female ratio should be at a selective disadvantage considering, under the circumstances, that the female is the "more expensive" sex to maintain.

ASMUNDSON, VIGFUS S. *See* ABBOTT, URSULA K.

ASTAUROV, B. L. Artificial Parthenogenesis and Polyploidy in the Silkworm *Bombyx mori* L. *Severtzow Institute of Animal Morphology of Academy of Science of USSR, Moscow, U.S.S.R.*

By means of heat activation of silkworm unfertilized eggs it is possible to obtain up to 82% of complete parthenogenetic development and, of these parthenogenetic offspring, 100% are females. As in the natural thelytokys parthenogenesis, accompanied as a rule by polyploidy, the thermal artificial parthenogenesis facilitates the appearance and further preservation of polyploidy. Primary occurrence of polyploidy takes place in the course of parthenogenetic cleavage. When polyploidization occurs in the germ track cells, the parthenogenetic females produce large tetraploid eggs as well as normal diploid ones. The unfertilized $4n$-oocytes in their turn may be stimulated to parthenogenesis which leads to the appearance of the $4n$-females and later on of the corresponding parthenoclones. By crossing ♀ $4n \times$ ♂ $2n$ the triploids of both sexes are easily produced. Owing to the aneuploidy of their gametes the triploids are quite sterile whether intercrossed or mated with normal diploids. But in the heat-activated unfertilized $3n$-oocytes, as in the $2n$ and the $4n$, the maturation proceeds ameiotically, the reduction division is suppressed and only the equation division remains. This opens the possibility of reproducing the triploids parthenogenetically, obtaining $3n$-clones and propagating them indefinitely by means of heat activation. Strangely enough some of the parthenogenetic $3n$-females when crossed to $2n$-males unlike their $3n$-mothers of bisexual origin are not absolutely sterile but give a small percentage of viable offspring of both sexes (approximately 1% on the average). The explanation is simple: whereas in diploid heat parthenogenesis sporadic polyploidization results in the appearance of $4n$-oocytes, in triploidy it leads to the appearance of $6n$-oocytes. When fertilized, the hexaploid oocytes maturate quite regularly and a $3n$-female pronucleus arises and after its union with the haploid sperm nucleus, a tetraploid zygote results. Previously the $4n$-males occurred in *Bombyx* as an extreme rarity. Now crossing of a parthenogenetic $3n$-female to the $2n$-male is the easiest way of obtaining $4n$-silkworms of both sexes in any desired number. Unfortunately the $4n$-males are sterile and a sexually propagating $4n$-race has not yet been obtained. Owing to the elaboration of the reliable method, which permits the induction of ameiotic parthenogenesis in *B. mori*, the production and investigation of experimental polyploids in this insect are more accessible than in any other animal.

AXFORD, S. J. *See* NEWCOMBE, H. B., *et al.*

BAILEY, CATHERINE H., and L. FREDRIC HOUGH. Inheritance of Season of Ripening in Certain Peach Progenies. *Rutgers, The State University of New Jersey, New Brunswick, N.J., U.S.A.*

The mode of inheritance of season of ripening in peaches has been studied using crosses between Jerseyland and five early-ripening varieties or selections including Prairie Daybreak, and between Prairie Daybreak and another early ripening selection.

There are six loci which act in a cumulative way to shorten the time required for fruit to ripen. All the parents studied are homozygous for the contributing genes at four of these loci. Specific modifiers have been postulated for five of these loci. There are three loci with dominant genes which shorten the development period by two or more weeks. Another locus shortens the development period by two weeks when it is in the recessive condition. Dominance, epistasis, duplicate factors and modifiers can account for most of the variation in the ripening season in these progenies. In one progeny some of the variation in the time of ripening resulted from segregation of contributing factors.

Jerseyland and Prairie Daybreak, the latest ripening parents used, are homozygous for five pairs of contributing factors. They are both heterozygous at another locus which shortens the development period by two weeks when it is in the recessive condition. Different modifiers are present in each. All of the five earlier ripening selections and varieties contain the dominant gene B_2 plus various modifiers. Four of these are homozygous for the same five pairs of contributing genes present in Jerseyland and Prairie Daybreak. The selection 7039 contains the dominant D, four pairs of contributing genes common to the other six parents and one other contributing gene. The Prairie Daybreak × 7039 cross was the only one producing seedlings ripening earlier than Mayflower.

BAJER, ANDRZEJ, and JADWIGA BAJER-MOLÉ. Mitosis in Living Cells—a Film: Normal, β-irradiated and Colchicine Mitosis. *Laboratory of Plant Physiology, Jagellonian University, Cracow, Poland.*

The endosperm of many species is suitable for studies of mitosis *in vitro*. The cells, without cellulose cell walls, can be flattened by surface tension. In such cells the length of the same chromosomes was measured from prophase to telophase and their volumes calculated. The length decreases throughout the whole of mitosis and the volume increases until the metaphase is reached and decreases during the anaphase. Observations on the course of mitosis indicate the following. The first sign of the spindle is the clear structureless zone which appears around the nucleus and when it reaches maximal dimensions the nuclear membrane breaks. This clear zone is the cytoplasmic constituent of the spindle. Formation of the clear zone is probably initiated by substances migrating from the nucleus.

The moment of nuclear membrane dissolution may be exactly estimated; it is followed by the sudden aggregation of the chromosomes in the central tighter mass (mitotic contraction stage). After this stage co-operation between kinetochores and the spindle takes place and the moment at which this begins (kinetochore stretching) may be seen in some cells.

During prometaphase the kinetochores do not always move to the equator by the shortest path and may move towards the pole and return. Acentric fragments are eliminated at the poles. Some chromosome arms execute peculiar movements (abrupt bending movements) which are absent in colchicine mitosis.

During the anaphase the changes inside the pushing body "Stemmkörper" cause the whole half-spindles to move apart. In the ana-telophase, during the formation of the phragmoplast, all particles and chromosome fragments are eliminated at the poles and the whole nuclei are pushed apart, giving the impression of a second anaphase during the early telophase.

BAJER-MOLÉ, JADWIGA. *See* BAJER, ANDRZEJ.

BAKER, HERBERT G. Observations on Heterostyly in Some Species of Tropical Plants. *Botany Department, University of California, Berkeley, Calif., U.S.A.*

The Rubiaceae, which provides important constituents of forest and savannah-vegetation in all parts of the tropics, is also celebrated as containing a larger number of heterostyled species than is yet known in any other family. In the tribe Psychotrieae, West African species of *Psychotria* and *Uragoga* are heterostylous and largely self-incompatible. In *Psychotria warneckei* K. Schum. and K. Krause, however, in addition to normally heterostylous plants, "cross-over" long-styled plants which are self-compatible have become established. This move towards secondary monomorphism may be correlated with the relatively unattractive flowers of this species and its weedy behaviour.

In the tribe Mussaendeae of the same family, at least two species of *Mussaenda* are found to be heterostylous (without the usual differences in pollen-size between long- and short-styled plants), but other species are shown to be functionally dioecious. The probable derivation of dioecism from heterostyly in this plant does not necessarily support the Darwinian belief that heterostyly is usually a stage on the path from hermaphroditism to dioecism, but is a special case deriving from the difficulty of transferring pollen from deep seated anthers to short styles in species with congested corolla-tubes.

In the Oxalidaceae, the trimorphic outbreeding system has been studied in the genera *Oxalis*, *Biophytum* and *Averrhoa*. Because of the greater complexity of this system compared with the dimorphic system, the number of ways in which it can break down to provide monomorphic, self-compatible populations is correspondingly greater. Illustrations of these are given. The correlation between monomorphism and weediness, on one hand, and establishment after apparently long-distance dispersal, on the other, are stressed for *Oxalis* and *Biophytum* and a brief comparison is made with conditions in the equally tristylous monocotyledonous family Pontederiaceae.

BAKER, WILLIAM K. and JANICE B. SPOFFORD. Heterochromatic Control of Variegation in *Drosophila melanogaster*. *Department of Zoology, University of Chicago, Chicago, Ill., U.S.A.*

It is well known in *Drosophila melanogaster* that extra Y-chromosomes suppress the extent of mutant areas in eyes which are variegated because of position effects at the white locus. This phenomenon allows one to determine experimentally if the Y heterochromatin can be subdivided into functional genetic units. Seventeen different Y fragments were tested in three genotypes of coisogenic flies carrying a duplication of the w^+ locus inserted into the centromeric heterochromatin of chromosome 3L. This rearrangement produces variegated eyes if a *w* allele is carried in the X-chromosome. The three genotypes tested were: X/Y^F males, $X{\cdot}X/Y^F$ attached-X females, and $Y^SX{\cdot}Y^L$ attached-X-Y males. Both visual and chromatographic measurements were made on the extent of pigmentation and on the amount of ultraviolet fluorescing pteridines, respectively, present in the 51 different genotypes being compared. The evidence seems conclusive that Y heterochromatin contains discrete functional units. For example, cytological study of the Y fragments indicates that not only do fragments of the same cytological length have different potencies in suppressing variegation, but that certain large two-armed fragments are very ineffectual in modifying the size of the mutant area in variegated eyes. Quantitative determinations of the amount of certain pteridines (probable precursors of the red pigment) in the variegated eyes clearly demonstrate the accumulation of particular pteridines in these eyes in excess of the amount present in wild-type eyes. This fact, in conjunction with chromatographic studies on comparable mosaic eyes produced by somatic loss of an X fragment containing w^+, provides some rather critical evidence as to whether the clonal appearance of the mutant areas in many of the variegated eyes (caused by position effect) is the result of gene mutation or whether it is based on altered gene action in a given region of somatic tissue.

BANGHAM, JEAN W. *See* RUSSELL, W. L., *et al.*

BAKHTEYEV, F. KH., and E. M. DAREVSKAYA. Spontaneous and Artificial Hybridization in the Genus *Hordeum* L. *Botanical Institute of the Academy of Science, USSR, Leningrad, U.S.S.R.*

The findings obtained from spontaneous interspecific and intergeneric hybrids and the results of experimental investigations on remote hybridization show that hybridization is one of the most striking and efficient factors in plant evolution.

The genus *Hordeum*, family Gramineae, includes, according to Nevsky, only 28 species, combined into 6 sections. The section Crithe Döll includes all cultivated barleys and one of their nearest relatives, the wild-growing annual *Hordeum spontaneum* C. Koch. In the U.S.S.R. 11 wild-growing *Hordeum* species are registered. As a result of many years of investigation, we distinguish three species among cultivated barleys: *H. vulgare* (L.) Vav. et Bacht., *H. aethiopicum* Vav. et Bacht., and *H. humile* Vav. et Bacht. The occurrence of natural hybrids among wild-growing species of barley have not been recorded. Artificial hybridization was begun by G. Bestehorn as early as the 1880's and still continues. Over 20 cases of hybridization between *H. bulbosum, H. jubatum, H. nodosum, H. brevisubulatum, H. murichum* and cultivated barley species are known. As a result of artificial crosses between barley and species of *Elymus, Secale, Agropyron, Bromus, Festuca* (started under the direction of Zizin in the thirties) occasional, absolutely sterile intergeneric hybrids were obtained, particularly a hybrid between cultivated barley and *Elymus giganteus*, *Elymohordeum Zizinii*, Bacht. et Dar.

The overwhelming majority of crosses between members of different species, belonging to different genera or even to the same genus, fail. Nevertheless, successful instances of remote hybridization prove the possibility that further studies may overcome incrossability. Overcoming sterility is probably the most difficult problem. This is confirmed by exceedingly rare cases, where F_1 hybrids were transformed into fertile ones. However, studies conducted during the last decade show that persistent experimental work in this direction, based on the use and further development of modern cytogenetical methods, may greatly contribute to the overcoming of remote hybrid sterility.

Barber, Horace Newton. The Processes of Natural Selection. *University of Tasmania, Hobart, Tasmania, Australia.*

The method of estimating the magnitude of selective forces in natural populations are the *dynamic*, where changes in gene-frequency over a known time are measured, and the *static* where conditions determining equilibrium frequencies of genes are examined. Both methods have been used to measure the Darwinian fitness operating in populations of Tasmanian organisms. They include the following.

(1) *Oryctolagus.* Since the introduction of rabbits to northwest Tasmania 40 years ago, a cline in the frequency of blacks, which rises from $<1\%$ on the coast to about 30% 20 miles inland, has developed. On the coast the dominant wild-type allele probably has the greater fitness, whilst inland its fitness falls to 80–95%. Similar clines for coat-colour genes occur in the native marsupial *Trichosurus.* In both animals the black is favoured in areas of high rainfall carrying southern rain-forest.

(2) *Eucalyptus.* (*a*) In clearings maintained for 40 years under transmission lines, changes in frequencies of genes controlling flavonoid production in young leaves have occurred in eucalypt coppice and saplings. Preliminary estimates indicate about a 5% increase in the fitness of red as compared with yellow-green when the forest canopy is removed. In untouched forest there is evidence of a cyclical change in fitness, the fitness of genes for red flavonoid gradually decreasing as the canopy matures. This cycle of selection maintains a true morphic balance over wide areas.

(*b*) A comparison of frequencies of waxy-glaucous plants in adult forest with those in seedlings produced from mothers along steep altitude clines has given direct evidence that in *E. urnigera* genes for wax-production are effectively "lethal" at the lower altitude limit (2000 ft.); 1000 ft. higher such genes are essential for survival.

(3) In *white human populations* established 100–150 years ago, Scott has shown that a clinical pattern of performance in a standard ability test has appeared. Children of settlers in marginal lands (which usually coincide with black rabbit country) have a consistently lower performanec than children in good agricultural areas or towns. It is suggested that differential migration is the explanation of the origin of the cline.

In all these cases, fitnesses change rapidly and greatly in both space and time. The evolutionary implications of such systems of selection will be discussed, in relation to sampling "drift," the origin of correlated variation (often interpreted as "introgression") and the possibilities of sympatric speciation.

BATEMAN, ANGUS JOHN. The Two Classes of Dominant Lethal in the Mouse. *Christie Hospital and Holt Radium Institute, Manchester, England.*

When a female mouse is dissected on the thirteenth day of pregnancy, any dominant lethals will be recognisable either as a discrepancy between the numbers of corpora lutea and implantations, or as deciduomata. Later deaths are infrequent and seem to bear no relation to the mutation rate. Sections of deciduomata show no sign of embryo, even as early as the fifth day. On the other hand, all eggs, even unfertilised ones, are still present in their zonae pellucidae on the fourth day. It follows that all dominant lethal ova disappear within a period of about 24 hours around the time of implantation. During this period some invoke a deciduomatal reaction by the endometrium and others do not. The partition between these two phenotypes of dominant lethal is not a matter of pure chance, as it varies systematically with the over-all incidence of lethals.

Study of this variation leads to the conclusion that it is consistent with the hypothesis that all eggs with a single lethal, and a constant fraction (about one-quarter) of those with more than one lethal, invoke a deciduomatal response. It is hoped to distinguish two classes of lethal cytologically.

The partition between the two types of lethal follows the same pattern for X-rays and triethylenemelamine, implying that a Poisson distribution of breaks per egg results from both mutagens.

BATEMAN, NIGEL. Response of Mice to Selection for Lactation. *A.R.C. Animal Breeding Research Organisation, Roslin, Scotland.*

Selection for lactation performance in mice has been carried in both upward and downward directions through 20 generations. A number of reverse selections were made in parallel with the two forward lines to assess the magnitude of heritable variation within these lines. The responses within these single populations to the two-directional selections indicated that heritability was 0.5 and did not change during the experiment. Somewhat lower estimates of heritability were obtained from the variance between full-sib families, and from the regression of daughter on dam, computed within selection groups.

It is doubtful whether the high line responded to the selection, and the response of the low line was not maintained at its initial level. The earliest generations of the high and low lines diverged in accordance with the estimated heritability of 0.5, but by the twentieth generation the realized heritability had diminished to 0.17; i.e., only one-sixth of the total selection applied up to the twentieth generation appeared as a difference between the two lines. The inference is that the response to reverse selection averaged 0.83. This corresponds to a five-fold change in response following a change in the direction of selection.

It appears that a natural mechanism (as yet unidentified) opposes departure from a particular level of lactational performance. However, the lactations of reciprocal crossbreds between the two lines are identical, and this excludes maternal effects as explanation.

Battaglia, Bruno. Polymorphism and Relationships with the Environment in *Tisbe reticulata. Istituto di Zoologia dell'Università, Padova, Italy.*

The harpacticoid copepod *Tisbe reticulata* is a polymorphic species. As previously described by Bocquet, the various forms are characterized by a different distribution and intensity of the colored pigment in the cephalo-thorax and the free thoracic segments. In the brackish waters of the lagoon of Venice four major forms have been found. The results of crosses made in the laboratory show that the color patterns in the animals of this population are due to a series of at least three allelomorphs at the same locus: V^V, V^M and v, of which the first two are dominant over the common recessive v. The heterozygote $V^V V^M$ *is* phenotypically detectable.

Under optimal culture conditions, in which larval mortality is practically absent, the observed ratios in the F_2 of crosses between V^V and V^M agree with the expected Mendelian ratios. However when death occurs, during the period egg-adult, an excess of heterozygotes $V^V V^M$ and a deficiency of both homozygotes $V^V V^V$ and $V^M V^M$ can be observed. There is some indirect evidence that the heterozygotes $V^V v$ and $V^M v$ may also, under certain conditions, be more viable than both the respective homozygotes. The viability coefficients are modified by the degree of crowding and therefore by the larval competition in the cultures. The greater the crowding, the more the numbers of heterozygotes exceed the expected values. Salinity is another environmental factor affecting the adaptive values of the different genotypes. At a salinity of 26‰ the homozygotes $V^M V^M$ have a selective advantage over the homozygotes $V^V V^V$ and the heterozygotes $V^V V^M$. At lower salinities selection favours the heterozygotes. Other experiments now in progress will show whether temperature also plays a selective role. The results obtained so far indicate that in *Tisbe* heterosis acts to ensure the maintenance of genetic variability, in addition to other mechanisms which operate through a differential adaptation of the various forms to different environments.

Beardmore, J. A., Th. Dobzhansky, and O. Pavlovsky. Adaptive Polymorphism and Developmental Homeostasis in Populations of *Drosophila pseudoobscura. Department of Zoology, Columbia University, New York, N.Y., U.S.A.*

Seven populations of *Drosophila pseudoobscura* were started and maintained in cages at 25°C as follows: 2 containing the AR gene arrangement; 2 containing the CH gene arrangement; and 3 containing both AR and CH (initially 50:50).

After eight months (equilibrium attained), individual cups with pupae were removed from cages and the emerging flies were classified as to several characters: (*a*) body weight; (*b*) wing length (both); (*c*) number of flies emerging per cup.

The flies from cups in cages containing both gene arrangements were heavier and less variable in weight, had longer and possibly less variable wings, were less asymmetrical in the difference (intra-individual) between left and right wings, and were produced in greater numbers than those flies from cups in cages containing only one gene arrangement.

It is well known that in general the chromosomal polymorphism found in *D. pseudoobscura* persists in a variety of environments owing to the heterotic superiority of gene arrangement heterozygotes. This heterosis is most obvious in the competitive larval stages and leads to an excess of adult heterozygotes in populations. These results show that populations in which at most half the individuals are heterozygous are on average superior in a number of ways to homozygous populations. This superiority is expressed as an increase in general biological efficiency both within and among individuals. In other words, there is good correlation between heterosis and good homeostasis although the correlation varies for different characters. We do not as yet know what developmental reactions there may be between heterozygotes and homozygotes raised in the same culture, it is however possible that the observed superiority does not have a strictly additive basis but involves inter-genotype interactions.

BEARDMORE, J. A. *See* VETUKHIY, M. O.

BEARDMORE, JOHN A. *See* LEVINE, LOUIS.

BEATTY, ALVIN V., and JEANNE W. BEATTY. Cellular Mechanisms Involved in Radiation-Induced Chromosomal Aberrations. *Emory University, Georgia, U.S.A.*

These investigations are concerned with the source of energy for repair and recovery from radiation damage. The first microspore division of *Tradescantia paludosa* is being used as the biological material, X-rays (usually a total dose of 400 r) provide the source of radiation and the experimental variables include the use of oxygen at various concentrations, anoxia, different temperatures from 0°C to 45°C, carbon monoxide, sodium iodoacetate, and p-chloromercuribenzoate. It has been found, for example, that 400 r of X-radiation, administered at any intensity to material in 5% oxygen, will yield about 0.90 aberrations per cell when the energy-supplying system is inhibited by carbon monoxide, low temperatures or both. In an oxygen-free atmosphere a maximum of 0.65 aberrations per cell has been obtained following an anoxic condition extended to 400 minutes. Immediate radiation after the material is placed in an oxygen-free atmosphere yields only 0.24 aberrations per cell. Although sodium iodoacetate (M/1,000) and p-chloromercuribenzoate (M/10,000) when used as anaerobic inhibitors increase the aberration yield over controls about a hundredfold, the yield does not equal that produced with 400 min. of anoxia. Other concentrations of these agents and other methods of treatment are being employed.

BEATTY, JEANNE W. *See* BEATTY, ALVIN V.

BEATTY, RICHARD ALAN. Genetics of Mammalian Spermatozoa. *Agricultural Research Council Unit of Animal Genetics, Institute of Animal Genetics, Edinburgh, Scotland.*

The characteristics of mammalian spermatozoa can be regarded, from one point of view, as somatic characters of the male that are potentially subject to genetic influences conditioned by the diploid genotype of the male. It has been found (with the assistance of R. A. N. Napier) that the mean size of spermatozoon head varied widely in six genetic groups of rabbits that were more or less unrelated for the preceding four generations. Marked differences in the average size of the spermatozoa were also evident in eight inbred strains of mice (in association with N. K. Sharma).

From another view-point, the spermatozoa may be regarded as a haploid generation amongst whose individuals the genes of the immediately preceding diploid generation have been partitioned during meiosis. There might, therefore, be differences among spermatozoa attributable to their own haploid gene complements: i.e., the results of meiotic segregation might be demonstrable in the phenotype of spermatozoa (Beatty, Proc. Roy. Physical Soc. *25*: 39). Some preliminary results have been obtained in current attempts to demonstrate such phenotypic differences, with particular attention to segregations at a single locus, and to the segregation of X and Y chromosomes. Techniques for the statistical evaluation of bimodal curves have been explored.

The practical stimulus for this work is that if meiotic segregation is reflected in the phenotype of the spermatozoa then the possibility arises of artificial separation or of differential inactivation of spermatozoa according to their genotype. A more fundamental interest is that the genetics of the haplophase may have repercussions on the genetics of the diplophase.

BEAUDRY, JEAN-R. Contribution to the Study of the Process of Evolution in the Genus *Solidago* L. (Compositae: Astereae). *Institut Botanique, Montréal, Canada.*

Gradual speciation, polyploidy and hybridization are three factors which have undoubtedly participated in the evolution of the genus *Solidago*. Chromosome number determinations have shown that the basic number of this genus is nine. Since most of the species studied are diploid, it is evident that gradual speciation through selection of mutations and recombinations has been an important factor of evolution in *Solidago*. Polyploidy has been at the origin of at least two classes of biotypes: a first one in which the entities concerned have reached a level of macroscopic morphological differentiation such that they can easily be considered as good species by the standards of competent classical taxonomists; a second one in which the biotypes are still characterized by morphological features that are entirely or almost entirely microscopic. Intermediates between these two classes of biotypes evidently exist. Taxonomists have often reported hybrids in *Solidago*, but very little is positively known about their evolutionary contributions. However, comparative studies of various taxa on the basis of their morphology and chromosome numbers and also more detailed studies by biosystematic methods strongly point to a significant contribution by hybridization to the evolutionary history of *Solidago*.

BECKER, HANS JOACHIM. Puffing in the Salivary Gland Chromosomes of *Drosophila melanogaster*. *Department of Zoology, University of California, Berkeley, Calif., U.S.A.*

Puffs are formed in the salivary glands of this species and are most numerous beginning about 5 hours before puparium formation. It was suspected that 108 short sections of the 5 long chromosome arms were subject to puffing because of their sometimes relatively wide and light appearance. About one-third of these sections actually form puffs, i.e., they are enlarged only at certain stages of development, whereas the remainder have more or less the same structure during all developmental stages. This was determined by investigating the chromosomes of different larval and prepupal stages, beginning 70 hours after hatching, the earliest analysable stage so far. During the last few hours of larval life, when the developmental stage of a larva cannot be determined exactly by its chronological age, use was made of the regularity with which some sections are puffed simultaneously while others are never seen puffed together. If, for example, A + B and B + C are sometimes simultaneously puffed, whereas A only in younger and C only in older stages, the sequence of occurrence with advancing development must be ABC. For the interval studied a timetable could be constructed with 18 consecutive stages, each of which is characterized by a certain puffing pattern. Each puff appears at and stays for a specific time. Some of them stay approximately one hour. Furthermore puffing differences have been found between the anterior transparent and the posterior opaque parts of the gland. Also being studied are the possible effects of various mutational changes in the length of larval life on the sequence pattern of puffing. Larvae homozygous for lethal giant larvae (*lgl*) never form any of the puffs which appear in normal larvae during the last 5 hours of larval life. Investigation of the mutant factor giant (*gt*) is in progress. (This study was aided by a grant from the National Science Foundation.)

BECKER, WALTER A., and LAWRENCE R. BERG. The Sensitivity of Chickens to Differences in Diet. *State College of Washington, Western Washington Experiment Station, Puyallup, Wash., U.S.A.*

The sensitivity of chicken populations to environmental changes was studied in relation to the concept of genetic homeostasis. The trait used was body weight. The F statistic, between environments mean square/within environments mean square, was used to measure sensitivity.

In the first experiment male and female White Rocks were each divided into two groups (N = 263) at hatching. One group was fed a diet that produced rapid growth and the other group a diet that gave slow growth. Body weights were taken at one, four, and eight weeks of age. Males were more sensitive than females and the birds were more sensitive at four weeks than at one or eight weeks.

Males of highly inbred White Leghorns, slightly inbred White Rocks, a heterozygous Synthetic breed and a White Rock female × Synthetic male cross were each divided into two dietary groups (N = 36) at hatching. Weekly weights were taken from one to eight weeks of age. The highest sensitivity occurred when the birds were two weeks old. At that age White Rocks and White Leghorns were equal in sensitivity followed by the Cross-breds and the Synthetics. All genotypes except the Cross-breds decreased steadily in sensitivity after two weeks. The Cross-breds increased in sensitivity and were more sensitive than the other genotypes at seven and eight weeks of age.

Variances on the geometric scale indicated that the inbred White Leghorns were the most variable throughout the experiment. The White Rocks had the least variability at two weeks of age while the Cross-breds had the lowest variability at seven and eight weeks. The main factors that affected sensitivity were the sex and age of a population while variability did not appear to be related to this trait.

Bednekoff, A. G., W. H. Stone, M. R. Irwin, and K. P. Link. Chemical Studies on the J Substance of Cattle Serum. *Departments of Biochemistry and Genetics, University of Wisconsin, Madison, Wis., U.S.A.*

The J substance of cattle blood has been described as a heritable antigenic character present primarily in serum and acquired by erythrocytes. The serological and immunochemical properties of the J substance obtained from bovine gastric mucosa indicated that it was related serologically and chemically to the blood group A substance of man. The preparations from bovine gastric mucosa consisted primarily of polysaccharides similar to those previously described for the blood group substances of man. Because the isolation procedure (phenol-extraction) removes protein, it is possible that protein is always associated with the J substance. The J activity of serum as measured by hemolysis inhibition was removed completely by perchloric acid, sulfosalicylic acid, trichloroacetic acid and 90% phenol, suggesting that J activity of serum is associated with protein. The J activity of serum and of gastric mucosa preparations was destroyed by sodium meta-periodate and periodic acid, suggesting further that polysaccharide is involved in J activity. Electrophoresis of untreated J active serum indicated that the J substance is in the α_1 and α_2 globulin fraction of the serum proteins. However when serum was fractionated by an alcohol precipitation method (Cohn "10") all of the J activity was found in a single fraction which contained six components by electrophoresis. The J substance of serum is remarkably heat stable. After heating at 98°–100° C for 15 minutes, the serum lost about 90% of the original protein but had nearly the same J activity as the untreated serum. Electrophoresis of this heat stable fraction showed four components; the largest component (60%) had the mobility of an α globulin and possessed about 70% of the activity of the untreated serum. These data indicate that the J substance of bovine serum is a glycoprotein with electrophoretic mobility similar to the α globulins of serum.

Belgovsky, M. L. The Shape of Frequency-Dosage Curve for Recessive Lethals in *Drosophila* in Relation to Differential Radiosensitivity of Different Stages of Germ Cell Development. *Institute of Biophysics, Academy of Sciences of the USSR, Moscow, U.S.S.R.*

The shape of the frequency-dosage curve for radiation-induced recessive lethals in *Drosophila* was one of the main facts on which the conception of the mechanism of mutagenic action of ionizing radiations was founded. After the discovery of differentional radiosensitivity of different stages of gamete development in *Drosophila* it became clear that the material used for the establishment of the shape of this curve was biologically heterogenous inasmuch as it consisted of cells of different radiosensitivity. Muller with co-workers has shown that the frequency of lethals induced in spermatids increases much more slowly than does the dose of radiation. This raises the question, why does the integral frequency-dosage curve for lethals retain its linearity?

In order to answer this question, we treated wild-type *Drosophila* males with 1,000 and 4,000 r of X-rays and recorded the frequency of recessive lethals in gametes, which at the time of irradiation were at the stages of mature sperms, spermatids and spermatogonia, correspondingly. In spermatids 4.3% of induced lethals were recorded at 1,000 r and 6.64% at 4,000 r, a fourfold increase of the dose raising the frequency of mutations only by a factor of 1.54. These data are in agreement with those of Muller *et al.* At the same time the frequencies of lethals in mature sperms were found to be 1.79% and 5.96%, correspondingly. These figures do not significantly deviate from those expected in the case of linear dependence, with due allowance for the saturation effect.

It is thus obvious that the shape of the integral frequency-dosage curve for lethals is wholly determined by the mode of dependence upon dosage of the frequency of lethals in mature sperms. The lagging of the lethal frequency in spermatids behind that expected on the basis of a direct proportionality rule practically is not at all reflected on the shape of the integral curve. This is evidently to be explained by the fact that the absolute number of lethals originating in spermatids is very small, as compared with that of lethals originating in mature sperms, because at any given moment the latter are much more numerous than the former.

This study shows that the possible heterogenity of the stage of development of the treated germ cells, not considered in many previous investigations of the dependence of mutation frequency upon the dose of radiation, does not invalidate the conclusions drawn from such investigations, provided these conclusions refer to mature sperms only.

BELIAEVA, V. N. *See* PROKOFIEVA-BELGOVSKAYA, ALEXANDRA, *et al.*

BELL, A. E., and C. H. MOORE. Further Comparisons of Reciprocal Recurrent Selection with Conventional Methods of Selection for the Improvement of Quantitative Characteristics. *Poultry Science Department, Purdue University, Lafayette, Indiana, U.S.A.*

Reciprocal recurrent selection (RRS) was compared in two experiments with individual and family selection (IFS) for improving a highly heritable trait, body weight in the flour beetle, *Tribolium castaneum.* In both experiments the two methods were equalized on the basis of population size (56 families with 20 males and 20 females weighed each generation). By limiting selection to sire testing under RRS, generation cycles were maintained simultaneous with IFS. Inbred lines were developed from each of the 8 common foundation stocks for subsequent comparisons in hybrid combinations with populations under RRS and IFS. For control lines, the initial closed populations were reproduced each generation by random mating.

The initial mean body weights in micrograms were practically equal for all populations at 2,150 for males and 2,300 for females with a standard deviation of 250 micrograms. Heritability of body weight in the initial populations was high (.60–.80) and the superiority of IFS was apparent in both experiments by the third generation. After sixteen generations of selection in both experiments, representative inbred lines were crossed in hybrid combinations to yield the following comparisons of mean body weight of both sexes in micrograms: Experiment I—IFS = 4,683, RRS = 3,002, largest hybrid = 2,936, $\bar{x}$ of 11 hybrids = 2,381, control = 2,265; Experiment II—IFS = 4,561, RRS = 2,999, largest hybrid = 2,812, $\bar{x}$ of 10 hybrids = 2,363, control = 2,187. Much of the superiority shown by the closed population method is a function of a larger selection differential which was inherent in the design. These results confirm our earlier *Drosophila* findings in showing that reciprocal recurrent selection is an inefficient method for improving quantitative traits influenced largely by additive gene effects. Its role in improving heterotic traits has yet to be clearly delineated. (This work was supported by grants from the Rockefeller Foundation and the National Science Foundation.)

BELL, A. E. *See* MARTIN, G. A.

BELLUOMINI, H. W. *See* SCHREIBER, GIORGIO, *e tal.*

BENDER, HARVEY A., and ROBERT C. KING. Studies on the Expression of Various *Singed* Alleles in *Drosophila melanogaster. Department of Biological Sciences, Northwestern University, Evanston, Ill., U.S.A.*

The 14 *singed* stocks of *Drosophila melanogaster* studied can be subdivided into four categories: (1) fertile, with kinked hairs and gnarled bristles—sn^3; (2) fertile, with kinked bristles only—sn^2, sn^4, sn^{34e}; (3) sterile, with kinked hairs and gnarled bristles—sn^1, sn^5, sn^{50k}, sn^1sn^2, sn^1sn^3, sn^1sn^4, sn^2sn^3, sn^{x2}, sn^c; and (4) sterile, with gnarled bristles only—sn^{36a}. The stocks containing two pseudoalleles on the same chromosome were synthesized by Professor W. M. Hexter. The ovaries of mutants of class (3) show an increased frequency of degenerating chambers and stage 14 oocytes are invariably misshapen. The ovaries of females homozygous for sn^{36a} show further abnormalities. Oogenesis usually ceases at stage 12. The nuclei of nurse cells in stages subsequent to 4 show a reduced amount and an abnormal distribution of both DNA and RNA (as measured by the Feulgen and azure B bromide procedures). Adult females were fed medium supplemented with RNA (1 part per 20 parts medium) to see if the abnormal behaviour of the nurse nuclei could be modified. No difference was observed between the ovaries from sn^{36a} females fed upon normal or supplemented media. However, added RNA appears to slow down the rate of development of post-yolk stages in $sn^{36a}/+$ flies. The effect of DNA-supplemented medium is under study. Oogenesis is normal in ovaries from flies of the following genotypes: sn^{36a}/sn^3, sn^{36a}/sn^2, sn^{36a}/sn^4, and sn^{36a}/sn^{34e}. Oogenesis resembles that found in class (3) in ovaries from sn^{36a}/sn^1, sn^{36a}/sn^1sn^2, sn^{36a}/sn^1sn^3, sn^{36a}/sn^1sn^4, and sn^{36a}/sn^2sn^3. Note that females homozygous for either sn^2 *or* sn^3 alone are fertile. Hairs are not kinked in females of the following genotype: sn^{36a}/sn^1, sn^{36a}/sn^3, sn^{36a}/sn^1sn^2, sn^{36a}/sn^1sn^3, sn^{36a}/sn^1sn^4, and sn^{36a}/sn^2sn^3. The bristles of sn^{36a}/sn^2 flies are kinked rather than gnarled. A hypothesis will be described which attempts to explain the action of this complex locus upon fertility and upon bristle and hair morphology. (Work supported by the U.S. Public Health Service, N.S.F. and USAEC.)

BENDER, MICHAEL A. A Comparison of the Rates of Chromosome Breakage Induced by X-Rays in Somatic Cells of Humans *in vitro* and of the Monkey *Ateles in vitro* and *in vivo. Department of Biology, The Johns Hopkins University, Baltimore, Maryland, U.S.A.*

Diploid cells from the second passage in tissue culture of epithelial-like cells isolated from several normal human kidneys have been exposed to doses of hard

X-rays ranging from 10 r to 200 r. At various times after irradiation these cells have been fixed and stained and then scored for chromatid-type chromosome aberrations. All of the expected types of aberration were found to occur. The induced breakage rate was found to be about 0.3 break per 100 cells per roentgen. In order to compare breakage rates *in vitro* and *in vivo*, further experiments were performed using somatic cells of the monkey *Ateles*. This animal has a diploid chromosome number of 34, which, coupled with the fact that the chromosomes are large and easily identified, makes it a very suitable experimental primate. Surgical removal of one kidney made it possible to make tissue cultures for *in vitro* studies parallel to those made with human cells, and also permitted the use of the same animal for *in vivo studies*. For the latter studies bone marrow was removed from the femur at various times after irradiation. X-ray doses of 10 to 100 r were used in these studies. The preliminary results of the *in vitro* experiments on *Ateles* cells confirm the results for human cells. The preliminary results of the *in vivo* studies show that it is possible to score properly treated bone marrow cells for chromatid-type aberrations. Although the amount of material scored to date is small, no difference between the *in vitro* and the *in vivo* experiments has become apparent, either in the breakage rates or in the types of aberration found. (This work was supported by a fellowship from the United States Public Health Service and by contracts with the United States Atomic Energy Commission.)

BENDER, MICHAEL A. *See* METTLER, LAWRENCE E.

BENNETT, J. H., and H. N. ROBSON. A Possible Genetic Basis for Kuru. *University of Adelaide, Adelaide, Australia.*

Kuru is a neurological disease involving progressive degeneration of the extrapyramidal motor part of the central nervous system and associated with marked ataxia. It has been found only in the Forei people of New Guinea, a linguistic group of about 20,000 who live in comparative isolation in a remote part of the highlands in the southeastern part of the island. There is great variation in the age of onset of the symptoms of Kuru, but once manifest the course of development of the disease seems to be uniform and death almost invariably results in from six to nine months. At present, Kuru accounts for about 60% of deaths among Forei women and about 10% of deaths in males. The collection and analysis of family records presents great difficulties. Nevertheless, several hundred families have now been recorded. The analysis of these records suggests that Kuru may have a genetic basis.

BENNETT, JACK. Sib Selection in Small Populations of *Drosophila melanogaster* Meig. *Biology Department, Northern Illinois University, DeKalb, Ill., U.S.A.*

A heterogeneous stock of *Drosophila melanogaster* Meig. was produced from 26 non-resistant laboratory and wild strains. It was proliferated in population cages and sub-populations extracted for selection. Samples of each of an initial group of 46 pair mating progenies were tested in vials lined with DDT-impregnated paper to determine resistance to kill. The untested sibs from the 20 most resistant and the 20 least resistant progenies were used to make up 50 pair matings to start each of the prospective lines (High = resistant, Low = susceptible). Similar testing and selection was carried out on subsequent generations for each line. After the first generation each line was duplicated, thus 2 High and 2 Low lines, all from the same population, were selected. Selection was carried on for 15 generations. At the end of the period of selection the median lethal doses for the High lines were approximately 125 and 625 times as great as those for their respective paired Low lines, and approximately 25 times as great as the median lethal dose for the control population cage.

The method of sib-selection ensures that the reproductive individuals of each generation were never exposed to the selective agent. The resistance developed compares favorably with the resistance of a variety of lines from our and other laboratories that were produced by direct selection.

An analysis of the chromosomal distribution of the genetic factors for resistance and susceptibility is in progress.

BERG, LAWRENCE R. *See* BECKER, WALTER A.

BERG, R. L. The General Evolutionary Principle Underlying the Origin of Biological Homeostasis. *Department of Darwinism, Leningrad University, Leningrad, U.S.S.R.*

In living beings homeostasis is expressed by the independence of their forms and functions from the accidental variation of environmental conditions. Stability is a particular manifestation of this autonomy. An investigation was undertaken to establish the diversity of the degree of stability of various characters of species, to find out the adaptive significance of this diversity, and to reveal the mechanism leading to the origin of higher degrees of stability.

Dimensions of different parts of 20 species and varieties of angiosperms have been studied. The degree of stability is expressed by the ratio V max/V min and by the variation coefficient; the degree of independence by the correlation coefficient. The absence of correlation indicates the independence of dimensions of the organ in question from the dimensions of other parts of the organism.

Comparison of the vegetative and reproductive characteristics shows the higher stability of the latter in all the species and varieties studied. High correlation coefficients have been detected for the dimensions of stems, leaves and inflorescences. The especially high degree of stability as well as the absence of correlation has been detected for the corolla and for stamens of plants pollinated by specialized insects. In self-pollinated plants as well as in plants pollinated by unspecialized insects or inanimate agents, a relatively low degree of stability of reproductive characteristics and no independence of their dimensions are observed. Stability and independence are thus inherent in dimensions of those parts of dorsoventral laterally placed flowers which participate in the process (described by Darwin, and recently by Schwanvitsch) of precise localization of pollen on a definite part of the body of the specialized insect. Specific pollinating insects act as selective agencies with respect to dimensions of certain parts of flowers. They take no part whatever in the formation of flowers during ontogeny. In higher organisms formative and selective factors never coincide. The lack of coincidence between formative and selective factors is the general principle underlying the origin of homeostasis. In the process of evolution this principle came into action simultaneously with the origin of the alternation of generations, and acquired special importance after the origination of ontogeny. Coding inherent in the physical basis of heredity is its direct consequence.

Berg, Roy T., and John P. Bowland. Observations on Genotypic Response of Swine to Energy and Protein Levels in the Ration. *Department of Animal Science, University of Alberta, Edmonton, Alta., Canada.*

Knowledge regarding non-linear interactions of heredity and nutrition over practicable ranges of nutritional status would be of value in relation to the formation of appropriate test rations for use in evolving improved strains of swine. Two strains of pigs, sired by Yorkshire and Tamworth boars, were fed rations differing in energy and protein levels from initial weights of 50–60 lb. to an average market weight of 195 lb. Four male and four female pigs from each strain were self-fed each of the following rations: Ration I, high energy (80% T.D.N.)-high protein (21 per cent crude protein) throughout; Ration II, high energy-high protein in the growing period to 110 lb. and high energy-low protein (13% crude protein) in the finishing period to market weight; Ration III, low energy (65% T.D.N.)-high protein throughout; Ration IV, low energy-high protein in the growing period and low energy-low protein in the finishing period. All rations were balanced with respect to other known nutrient requirements.

In the finishing period average daily gains were significantly different between rations and between sexes at P. $<.05$ with strain × sex interaction significant at P $<.01$. Efficiency of feed utilization in the same period differed between rations, strains and sexes at P $<.01$ with ration × strain interaction significant at P $<.05$.

Carcass measurements and scores were obtained as outlined in the National Bacon Hog Policy of the Canada Department of Agriculture. Where applicable adjustment for differences in warm carcass weight was made by covariance analysis. Ration groups were significantly different in percentage ham and belly scores at P $<.05$ and in total carcass scores at P $<.01$. Sexes differed in average back fat, percentage of ham, loin area, belly score and total carcass score at P $<.01$. All first order interactions for carcass characteristics among rations, strains and sexes were negligible. The magnitude of the difference in efficiency of feed utilization between two strains of swine varied with the ration fed, while differences in carcass merit between the strains remained quite constant over the rather wide ranges of protein and energy in the rations used.

Bergh, B. O. *See* Jenkins, J. A.

Bergquist, Arloa. *See* Wagner, R. P.

Berhmann, S. J. *See* Buettner-Janusch, John, *et al.*

BERNSTEIN, SELDON E., and LEROY C. STEVENS. Jaundice, a Congenital Microcytic Anemia of the House Mouse. *Roscoe B. Jackson Memorial Laboratory, Bar Harbor, Maine, U.S.A.*

A number of interesting hematological mutants are currently under study at the Jackson Memorial Laboratory. Jaundice, one of these, was recently discovered at this laboratory by Dr. Stevens. His studies indicate that the disease is inherited as a single Mendelian recessive, and that the homozygous recessive genotype dies shortly after birth. Ratios of normal to anemic embryos and newborns do not deviate significantly from the classical ratios although the diagnosis is complicated by the fact that some mice are born dead.

This condition which is invariably fatal within a few days of birth is characterized by a yellow coloration of the skin which becomes grossly visible within 6 hours of birth. *In utero* the affected offspring are pale but not yellow. Their livers, however, are large and congested, and soon after birth splenomegaly and cardiac enlargement become prominent features.

Analyses of the blood indicate a severe anemia, newborn *jaja* mice have average erythrocyte counts of 2×10^6 RBC/ mm.^{3} while counts of their normal sibs average 4×10^6 RBC/ mm.^{3}. The mean cell volumes of *jaja*'s range from 40–70 cubic microns as compared with 100–120 cubic microns for non-affected sibs. Large numbers of nucleated red cells, up to 400,000/mm.^{3} are found in the circulating blood, while many of the enucleated forms are bizarre in shape and staining capacity.

Morphologically the heterozygotes are indistinguishable from homozygous normals at birth and in adult life. The detection of these carriers so that production of jaundiced mice may be facilitated, and increasing the viability of the latter are two of the main problems under investigation. The report deals largely with these attempts, gross observations, and a comparison of jaundice with human and other murine anemias.

BERNSTEIN, SELDON E. *See* RUSSELL, ELIZABETH S., *et al.*

BHAT, N. R. *See* MURTY, B. RADHAKRISHNA.

BIANCHI, ANGELO. Genetic and Cytological Studies in Italian Maize Varieties. *Centro di Genetica, Università di Pavia, Pavia, Italy.*

To detect mutants in Italian maize varieties, self-pollination has been carried out in plants grown from seed collected throughout Italy. With the exception of plant colour characters the segregations were often very close to 3:1; in a few cases the ratio was 15:1. In a total of 290 selfed plants belonging to 170 different samples of open-pollinated populations, the following mutants have been observed: defective seed (12 types), sugary endosperm (1); virescent (24); glossy (20); albino (18); luteus (12); yellow-green (11); yellow stripe (6); abnormal growth (6); pale green (5); liguleless (4); fine stripe (3); brownish midrib (2); irregular (necrotic?) glossy (2); pigmy (1). Out of the 12 defective seed factors observed just one is from Northern Italy, which however contributed about two-thirds of the samples studied. Several weak alleles of the tunicate type have been collected, especially from Middle and Southern Italy. Cytological study dealt chiefly with the knob number and knob location. The average knob figure is low and never exceeds four. The identification of the single knobs has been possible in most cases. The most frequently observed knobs were on the long arms of chromosomes 7 and 8, and on the termination of the short arm of 9. No abnormal chromosome 10 has been observed; the heteropicnotic region close to the centromere in the long arm of 7 is often difficult to detect; a prominent chromomere may be observed following the knob in the long arm of 8, closer to it than in American strains. B chromosomes have been found in one plant only. Incomplete synapsis or precocious desynapsis was occasionally present in the pachytene chromosomes. In two plants, metaphase I showed few bivalents and several univalents. The chromosome pachytene spreading as well as the staining was quite variable. Very clumped type of pachytene configuration, however, has not yet been found.

BIANCO, I. *See* SINISCALCO, MARCELLO, *et al.*

BISHOP, C. J. Radiation-Induced Morphological Changes and Fruit Color Mutations in the Cortland Apple. *Canada Department of Agriculture, Experimental Farm, Kentville, Nova Scotia, Canada.*

Following a brief survey of the history of using radiation to induce morphological and genetic changes in agriculture, work at Kentville, using X-rays and thermal neutrons on apples, is discussed and summarized. About 13,000 dormant scions have been treated and then grafted into grown trees by the framework method. Dosages ranged from 3,500 to 5,000 roentgens of X-rays and 4 to 6×10^{12} thermal neutrons per $cm.^2$.

Morphological effects in growth from scions of the variety Cortland included distorted leaves, splits in leaf shape and veining, bifurcations of growing shoots and giant size of the first fruits. The latter may have been a physiological effect due to the grafting procedure. Genetic changes included frequent sectorial chimaeras in skin color, increased or decreased red color, and at least two branches on which the apples were complete sports and of a dark red color. The latter were very distinctive in the shade of red, being as dark in color as the variety Macoun.

The results obtained indicate that artificial radiation may become an important tool in apple breeding research. It is necessary, however, to process large numbers of scions to have a reasonable chance of success.

BLICKENSTAFF, JOYCE, PATRICIA SARVELLA, and R. A. NILAN. Pachytene Chromosome Analysis in Barley. *State College of Washington, Pullman, Wash., U.S.A.*

The genetics of barley has been studied more intensively and the linkage groups characterized by more known loci than most crop plants. The extreme difficulty of identifying individual chromosomes at mitosis and meiosis has hindered the assigning of linkage groups to specific chromosomes. Study of pachytene chromosomes in varieties and strains previously examined has been particularly unrewarding because of unsatisfactory spreading of the complement and staining of the chromomeres.

Microsporocytes of fertile lines derived from certain heterozygotes of the short chromosome (*sc*) strain of barley ($n = 7$) have proved to be favorable for pachytene analyses. Short chromosome is a meiotic mutant (Moh and Nilan, Cytologia *19*:48–53) which is characterized by extremely condensed diakinesis chromosomes and pollen sterility. In addition, the mutant exhibits relatively well-spread pachytene chromosomes. The selected fertile lines appear normal at diakinesis but retain the well-spread pachytene condition.

The problems of chromosome spreading and staining have been alleviated by examining freshly fixed (4 parts alcohol : 1 part acetic acid) microsporocytes that were subsequently stained in acetocarmine and smeared following steaming.

Except for the two satellited chromosomes, there appear to be no major distinguishing characteristics in the pachytene complement. Relative lengths and arm ratios are being used as the chief means of identifying the non-satellited chromosomes. The pachytene measurements have been compared with those obtained from somatic chromosomes of the same plants. Chromomere size, number, and pattern as well as tertiary constrictions are also being used to distinguish the different pachytene chromosomes.

In order to associate each linkage group with a specific chromosome, translocation tester stocks have been crossed to the selected lines.

BLUMBERG, BARUCH S. Studies on the Biochemical Genetics of Cattle: The Whey Proteins and Hemoglobins. *National Institute of Arthritis and Metabolic Diseases, National Institutes of Health, Bethesda, Maryland, U.S.A.*

Aschaffenburg and Drewry have reported that there are two kinds of β-lactoglobulins in the whey proteins of cow's milk. These can be separated by paper electrophoresis and their presence is determined by allelic autosomal genes. All three of the phenotypes, designated β_A, β_B, and β_{AB}, have been identified. We have studied the distribution of these proteins in herds of British, American, Icelandic and African (Zebu) cattle. During the course of these studies, it was noted that there were two types of α-lactalbumins in the milk of the African Zebu cattle which could be differentiated by paper electrophoresis. There is some evidence that these might be genetically determined. Among the breeds studied to date, the Zebu appear to be the only ones which have these two α-lactalbumins. Preliminary studies on the starch gel electrophoresis of whey proteins will be reported.

Bangham has reported on the existence of two types of hemoglobins in certain breeds of British and European cattle. Among British breeds, only the Jerseys, Guernseys and South Devons have this polymorphism. We studied the distribution of this trait in African herds. Of the five breeds of cattle studied, Nigerian, Zebu ("White Fulani"), Sudanese Zebu, Keteku (which are crosses with the Zebu), Muturu, and N'Dama, only the Zebu and Keteku had both kinds of hemoglobin. The last two breeds are relatively tolerant to trypanosomiasis, while Zebus are not. Whether this *prima facie* correlation with trypanosomiasis tolerance is more than coincidence will have to be determined by further investigation.

The significance of these biochemical polymorphisms will be discussed. Some comments will also be made on the relationship of these findings to the supposed affinity between Jersey cattle and the cattle of India.

(These studies were done, in part, in conjunction with Drs. M. P. Tombs and A. C. Bangham.)

BLUMEL, JOHANNA, E. BURKE EVANS, and G. W. N. EGGERS. Absence of the Sacrum and Coccyx: A Genetic and Clinical Study. *Orthopedic Division, Department of Surgery, University of Texas Medical Branch, Galveston, Texas, U.S.A.*

Six cases of sacral and coccygeal anomalies in our clinic prompted us to initiate this investigation. A review of the literature indicated that the number of published cases by no means reflected the actual occurrence rate of these malformations. In addition, it was apparent that no genetic studies had been attempted. A complete review of the literature and compilation of statistics on congenital defects of sacrum and coccyx was therefore undertaken, and in March 1957 survey forms were sent to 300 orthopedic surgeons in the United States and Honolulu. As of March 1958 replies have been received from 63, 20 of whom had treated from 1 to 6 such cases. So far a total of 36 cases have been obtained in this manner. It was subsequently decided to survey each state by sending forms to hospital record librarians. In Texas 100 hospitals have been contacted. To date 32 have replied and 4 of these have furnished a total of 8 cases. The other states are now being surveyed. Results on 50 cases, including our own, with special reference to manifestations of hereditary abnormalities in collaterals and ascendants, are as follows: Sex distribution is 23 males, and 27 females. These include 2 negroes, 4 Latin Americans, 38 whites and 6 not stated. Of these 30 showed complete absence of sacrum and coccyx; 16 had partial absence and on 4 information was incomplete. Common associated congenital anomalies occurred in 34 index cases. These were: (1) additional vertebral anomalies, 24; (2) spina bifida occulta, 9; (3) arthrogryposis, 6; (4) harelip and or cleft palate, 3; (5) dislocated hips, 13; (6) club feet, 23; (7) congenital heart disease, 2; (8) strabismus, 2; (9) bladder and bowel involvement, 14. Deliveries of propositi were breech in 8 cases and 5 listed abortions numbering from 1 to 3 per family. In 8 case histories, congenital anomalies were present among siblings, maternal and paternal relations.

BÖHME, HELMUT, and UDO TAUBENECK. The Action of Bacteriophages on Rod-Cells and Penicillin-Induced Large Bodies of *Proteus mirabilis. Institut für Kulturpflanzenforschung* and *Institut für Mikrobiologie und experimentelle Therapie der Deutschen Akademie der Wissenschaften zu Berlin, Gatersleben, Kreis Aschersleben, Germany.*

In liquid culture medium with high concentrations of penicillin *Proteus mirabilis* develops spherical large bodies which are able to return to the normal rod-like form after artificial removal of the antibiotic. In connection with studies on phage-resistance of *P. mirabilis* the reaction of normal rod-cells and large bodies to the action of bacteriophages has been compared. Lysis of rod-cells grown in an antibiotic-free medium begins 21 minutes after initiation of adsorption of phages with a multiplicity of 5; it is completed after 30–40 minutes. The behaviour of a culture of penicillin-induced large bodies (6 to 8 hours old) after adsorption of phages with the same multiplicity is exactly like that of the culture of rod-cells. The latent period lasts 21 minutes too. Microscopic control showed that the large bodies were lysed completely. It is easy to isolate phage-resistant mutants of *P. mirabilis* by cultivation of the sensitive strain on solid media together with an excess of phages. Penicillin-induced large bodies of a phage-resistant mutant preserve phage-resistance; no lysis occurs. The experiments were carried out with 2 unrelated strains of *P. mirabilis* and their phage-resistant mutants. The results were identical for both strains. The sensitivity to phages of large bodies induced from phage-sensitive rod-cells leads to the conclusion that the receptors necessary for adsorption of phages remain intact after transformation of rod-cells into large bodies. This is a difference between large bodies of *Proteus* and protoplasts produced from *E. coli* and *B. megaterium* which generally are not able to adsorb phages (for exceptions see Lederberg and Claire, Frazer and Mahler). The resistance to streptomycin of large bodies of *Proteus* and protoplasts of *E. coli* also seems to be different. According to Lederberg and Claire penicillin-induced protoplasts of a streptomycin-resistant mutant of *E. coli* were inhibited by a streptomycin concentration of 20 μg./ml. In our experiments the penicillin-induced large bodies of *P. mirabilis* behaved in liquid media with 400 iu penicillin per ml. plus 40 u streptomycin per ml. in the same manner as in this medium without streptomycin; that means they were not inhibited. On solid media with serum, penicillin and streptomycin the streptomycin-resistant mutant forms L-colonies as on the same medium without streptomycin.

BONNER, DAVID M. *See* LACY, ANN MATHEWS.

BOOTHROYD, E. R. The Chromosomes of Canadian Populations of Atlantic Salmon, *Salmo salar* L. *Department of Genetics, McGill University, Montreal, Canada.*

Chromosome studies were undertaken in the hope that they might throw some light on the relationships between various Canadian populations of salmon, as well as between these and European salmon.

Three populations were studied: a spring-run population from Maria, in Gaspé, Que., and two fall-run populations, one from the Miramichi River, N.B., and the other from Cobequid, N.S. Acetocarmine squashes of young embryos were used.

Counts were somewhat variable because of the difficulty of the material, but all three Canadian populations showed modes of 56 chromosomes. It is concluded, therefore, that $2n = 56$ is the true number in these salmon. Both Prokofieva and Svärdson have reported $2n = 60$ for European populations.

The majority of chromosomes have terminal or sub-terminal centromeres. The longest of these rod-chromosomes is about four times the length of the shortest. The assignment of these chromosomes to their homologous pairs is usually not possible because the length differences are too small and the appearance of secondary constrictions (up to four in some chromosomes) is too variable to be reliable. Seven or probably eight pairs of chromosomes have median or sub-median centromeres, and of these two-armed chromosomes the longest is approximately twice as long as the shortest. No clear-cut differences in either the number or the morphology of the chromosomes have been established between the Canadian populations.

These Canadian salmon do not fit Svärdson's theory that the Salmonidae represent an old polyploid series, $x = 10$, in which no centric fusion or misdivision has occurred. However, if the Canadian salmon have eight pairs of two-armed chromosomes and $2n = 56$ and if the European have six pairs and $2n = 60$, as reported by both Prokofieva and Svärdson, then one may have evolved from the other by two centric fusions or misdivisions.

BOROJEVIĆ, SLAVKO. The Occurrence on Wheat of Branched Ears in the Crosses of Species with Unbranched Ears. *Faculty of Agriculture, Novi Sad, Yugoslavia.*

In the crosses of two common wheat varieties with *Tr. dicoccum*, none of them having branched ear character, some segregates showed branched ears in the F_4 and F_5 generations. In succeeding generations the branched ears segregate in branched (majority) and unbranched ears. The ratio of segregation was quite irregular. The branching was of a turgidum- and Vavilovii-like type.

All plants with branched ears belong to 14-chromosome species, turgidum or durum types. The majority of them have regular meiosis and only a few had a smaller number of univalents which disappeared in later generations. The sterility of branched ears, however, was high, particularly of the side ears. The plants with branched ears had a longer growing season than either parent. It was also observed that the side ears developed later than the central ear. Often the central ear was out of the shoot before the side ears appeared. The intensity of branching varied from year to year, in some years being quite pronounced, while in other years the side ears had only a few spikelets.

The occurrence of the branched ears in the crosses of the parents with unbranched ears has been explained as an interaction between the species used, expressed and influenced mainly by the environment. The day length and temperatures varied greatly in the years when the progeny of these crosses and especially the progeny of the branched ears from the F_4 generation onwards were grown. Short day length and the lower temperatures are considered as the most responsible factors for the expression and stability of the branched ear character.

BOSE, SMRITIMOY. Cytological Studies in Parental Types, and in Selfed and Crossed Progenies of *Sprekelia formosissima* Herbert. *Blandy Experimental Farm, University of Virginia, Boyce, Va., U.S.A.*

Cytological studies in *Sprekelia formosissima* Herbert have been confined to the study of chromosome number, reported by several workers to be between 110 and 121. The present investigation was undertaken to make a cytological survey of the genus from the large number of bulbs secured from several locations and from their selfed and crossed progenies.

The lowest number of $2n = 60$ was observed from bulbs collected near Cuernavaca, Mexico. Bulbs received from other sources not only had higher chromosome numbers but also exhibited a variation in numbers, in the root-tip cells. Peak frequencies were between 118–124, 148–155, and 164–178, suggesting that 120, 150 and 170 may be the regular somatic counts. Four different types of chromosomes could be distinguished in taxa with $2n = 60$ and in those with higher numbers.

F_1 seedlings of selfed and crossed plants from higher chromosome number types exhibited the same phenomenon of variation in numbers. The types of chromosomes were similar to the parental types. F_1 seedlings of $2n = 60$ taxa revealed a constant $2n$ number of 60 with parental types of chromosomes.

Repeated attempts to study meiosis, which occurs when the flower buds are still within the bulbs, failed, as did efforts to study mitosis in pollen tubes. Nevertheless a high percentage of fertile pollen and good pollen germination indicated a probable constancy of chromosome number in the pollen mother cells.

A study of chromosome types in taxa with 60 and with about 120 chromosomes apparently shows a regular increase in numbers of the several types, and indicates a polyploid series. Differences in size of the pollen grains between the two taxa could also be taken as an evidence for this hypothesis. Accessory chromosomes may possibly play a role in the cytological picture.

BOWDEN, WRAY, M. Phylogeny of Twenty-One Species of *Lobelia* L. section *Lobelia. Botany and Plant Pathology, Canada Agriculture, Science Service, Ottawa, Canada.*

The author's conclusions on the relationships of twenty-one species of *Lobelia* are based on correlated data derived from taxonomic, ecological, cytological, and genetic studies. A phylogenetic diagram is demonstrated and some of the vouchei specimens of the species and artificial interspecific hybrids are exhibited. There are fifteen diploid ($2n = 14$) species, one species with both diploids and tetraploids (*L. nuttallii*), three tetraploid ($2n = 28$) species (*L. glandulosa, L. amoena, L. elongata*), and two hexaploid ($2n = 42$) species (*L. floridana, L. paludosa*). There are four lines of speciation. In each of three lines, only a single diploid species has survived: *L. dortmanna, L. kalmii,* and *L. inflata.* The remaining eighteen species have evoled in one complex system of speciation in which there are three distinct subgroups: (i) seven small-flowered species: *L. feayana, L. nuttallii, L. canbyi, L. boykinii, L. gattingeri, L. appendiculata,* and *L. spicata*; (ii) four narrow-leaved species: *L. flaccidifolia, L. glandulosa, L. floridana,* and *L. paludosa*; and (iii) seven medium- to large-flowered species: *L. georgiana, L. brevifolia, L. puberula, L. siphilitica, L. cardinalis, L. elongata,* and *L. amoena.*

BOWLAND, JOHN P. *See* BERG, ROY T.

BRAGDØ, MARIE. *See* HUNTER, A. W. S.

BRAGE, DIEGO. Hepatolenticular Syndrome and Familial Hyperaminoaciduria: The Expression of Homozygotes and Heterozygotes. *Docente libre de Neurologia, Facultad Medicina, Buenos Aires, Argentina.*

The author presents a study of a family with an hereditary biochemical disease. The sub-clinical cases had aminoaciduria, the manifest clinical cases had hepatolenticular degeneration with all its neurohepatometabolic symptoms.

Our proband is a 27-year-old male with the hepatolenticular syndrome. A maternal aunt died of hepatolenticular degeneration at 30 years and a sister of the proband's maternal grandmother died of the same disease at 48 years of age.

The mother of the proband has hyperaminoaciduria. This biochemical difference was also noted in a 26-year-old sister, a 12-year-old brother of the proband, and in the son of the sole surviving descendant (a non-affected daughter) of the maternal aunt who died of hepatolenticular degeneration. The copper and protein fractions of the urine of the clinically normal people were investigated carefully and no abnormalities were detected.

This family is ethnically considered typically "criolla." All its known generations have been born and brought up in the Province of Entre Rios in the Argentina Mesopotamia. The "criollos" are the typical inhabitants of this area and were originally the products of a mixture of the Spanish conquerors and the Guarani Indians in about the 15th and 16th centuries.

The pattern of inheritance indicates that the hepatolenticular cases may be classified as homozygotes and the hyperaminoacidura cases as heterozygotes This then is a biochemical abnormality inherited perhaps as an autosomal dominant with variable expressivity. The heterozygotes may be the subclinical carriers of chemical symptoms.

It is interesting to note that copruria did not occur together with aminoaciduria which means that the latter is not secondary to the copruria.

BRAVER, GERALD. *See* CARSON, GWENETH L.

BRESLAVETS, LIDIA P. Significance of Plastids for Inheritance in Connection with the Problem of Their Origin. *Institute of Biophysics, Academy of Sciences of the USSR, Moscow, U.S.S.R.*

Some deviations from the Mendelian scheme of inheritance lead to the hypothesis of inheritance through the plasma. In the majority of cases, however, such deviations apply to the leaf coloration in the angiosperms, i.e., to the plastids. No attempts were made to connect plastid inheritance with the mode of their origin, as up to the present the hypothesis persists that plastids reproduce by division. This hypothesis is supported by the fact that the division of plastids actually takes place at all the stages of the phylogeny of plants with the exception of the angiosperms. Thorough study of this problem and the application of modern methods of cytological investigation showed that the plastids of most angiosperms have lost their ability to divide.

This is proved by the following facts. (1) The experiments in which the development of each single plastid in different cells of a leaf was followed up in an intact living plant showed the lack of division of plastids. (2) The slowness of the division of plastids in some angiosperms which preserved this ability is not in line with the rapid growth of the leaves in the angiosperms. (3) The development of plastids may proceed by another way, namely, through the transformation of mitochondria. The latter rise from the microsomes by means of the decomposition of complex organic molecules to smaller and simpler ones. (4) Inheritance of plastid characters proceeds in the angiosperms through the nucleus, with the domination of some characters in F_1 and their segregation in F_2 which was shown by cytogenetic experiments on the plastids of the petals of *Tropacolum majus* L.

The success of the angiosperms in the struggle for existence was due not only to the fact of their seeds being enclosed, but to the whole complex of characters, anatomical as well as physiological, which drastically distinguishes the angiosperms from other plant groups. To this complex there also belongs a more rapid growth of the meristem which would be hindered by the slow process of the division of the plastids.

BREWBAKER, J. L., N. SHAPIRO, and S. MAJUMDER. The Incompatibility Inhibition in Flowering Plants. *Brookhaven National Laboratory, Upton, N.Y., U.S.A.*

A great deal of attention has been focused on the genetics of incompatibility (S) alleles in flowering plants as well as on the physiology of pollen germination and growth in culture media. An attempt to wed these two approaches in order to determine the physiological nature of S-allele induced inhibitors will be described.

The inhibition leading to incompatibility takes place in at least two distinct ways: (1) the inhibition of pollen germination, peculiar to species with trinucleate pollen, and (2) inhibition of pollen-tube growth, common to species with binucleate pollen. A possible third group comprises species with binucleate pollen and hollow styles in which gametic fusion is inhibited.

In vitro studies of these types are in progress, largely employing S allele homozygotes. In each case the attempt is made to isolate allele-specific inhibitors and to minimize the effect of non-specific inhibitors (among these, sub- or super-optimal amounts of sugar and borate, sub-optimal pH, excessive concentrations of salts).

The class I inhibition of germination (e.g., broccoli, *Crepis*) has not been duplicated *in vitro*. In general such trinucleate pollens appear to have exceedingly high sugar and oxygen requirements for germination. Incompatibility is related to osmotic conditions, and often may be overcome (i.e., germination induced) by macerating stigmas or otherwise altering the stigmatic surface milieu.

There is mounting evidence that the class 2 inhibition of pollen-tube growth can be demonstrated with each of the seven alleles currently under test in petunia. Significant growth differences have been observed between pollen of incompatible and compatible genotypes when grown in extracts of styles in sugar-borate solutions. Methods of extraction, dialysis and heat lability studies, and preliminary chromatographic studies will be discussed.

It has been possible to disrupt synthesis of S-allele specific inhibitors in the style by X-irradiation. This is believed to be a possible cause of so-called "revertible mutations" which have been described for S alleles. (Research carried out at Brookhaven National Laboratory under the auspices of the U.S. Atomic Energy Commission.)

BRIGGS, J. B. *See* KNIGHT, R. L.

BRILES, W. E. The Role of Cross-Reactions in the Identification of *B* Blood Group Alleles in the Chicken. *DeKalb Agricultural Association, Inc. DeKalb, Ill., U.S.A.*

The antigens of the B blood group system exhibit a wide variety of cross-reactive patterns. When exposed to a sufficiently wide spectrum of blood typing reagents, each antigen takes on a specific pattern of agglutination. Genetic tests show that each antigen, with its complex cross-reactive pattern, is inherited as a singly segregating unit, presumably a single gene. Current data indicate that collectively the *B* blood group genes form an extensive series of alleles—over twenty-one having been reported in a recent study of twelve inbred lines by Briles, Allen, and Millen (Genetics, 1957). The analysis of the reactive patterns displayed by many different populations has revealed that few, if any, common alleles are encountered in comparing two genetically isolated breeding groups. The extreme serological and genetic diversity encountered in the B blood group system makes impractical the inclusion of such specificity differences in the antigen and allele terminology designations. A simplified system of blood group nomenclature compatible with these findings has been developed. Under this system the antigens in a population or species are designated individually by consecutive subscript numbers as B_1, B_2, B_3, B_4, etc.; the corresponding causative genes are indicated as B^1, B^2, B^3, B^4, etc.; and the reagents, regardless of their particular cross-reactive specificities, are simply designated B1, B2, B3, B4, etc., according to the antigen against which they were produced by isoimmunization. The multiplicity of cross-reactive fractions of antibodies, even in reagents prepared against the same antigen, is such that more detailed designations of reagents become quite impractical when employed widely in the species. This system of nomenclature has proved quite satisfactory in designating the blood group genotypes present in numerous commercial breeding populations and allows for expansion in time of a blood group system without necessitating revision of any of the designations for individual antigens, alleles, or reagents.

Brink, R. Alexander. The Genetic Basis of a Transallelic Change Occurring Invariably in Certain Maize Heterozygotes. *Department of Genetics, University of Wisconsin, Madison, Wis., U.S.A.*

The R^r gene in maize, which is ordinarily a stable factor conditioning self-colored aleurone, is changed invariably to a weakly pigmented form ($R^{r:st}$) in heterozygotes with stippled (R^rR^{st}). Stippled is an aleurone spotting factor, and shows no evidence of alteration in the process whereby standard R^r is changed to $\mathrm{R}^{r:st}$ in R^rR^{st} heterozygotes. Germinally transmissible mutations of stippled to self-colored aleurone occur in this stock at the rate of about 2×10^{-3}. Ten such independently occurring self-colored mutations were tested in heterozygotes with standard R^r for ability to change standard R^r. Nine of the mutants invariably induced the change from standard R^r to $R^{r:st}$; the remaining self-colored mutant exerted no effect on standard R^r in heterozygotes. These findings exclude the R^{st} allele, as such, and self-colored mutations from stippled, as such, as the promoters of the transallelic change in standard R^r. The active element may be (1) a unique component of the R^{st} allele, or (2) the "stippling component" itself, assuming R^{st} is a compound allele comprising an anthocyanin factor and a second element, the stippling component, which determines spotting. On the second hypothesis it is necessary to assume also that (*a*) the two elements are separable by transposition, or otherwise, and (*b*) the action of the stippling component varies according to chromosome position. It could be supposed, for example, that the stippling component conjoined with the basic color factor leads to aleurone spotting, whereas even slight displacement of the former results in self-color. Similarly, the transallelic effect of the stippling component on standard R^r may occur only when the stippling component is present at, or very close to, the *R* locus in the homologous chromosome.

Britton, Donald M. Chromosome Studies in *Rubus*. *Department of Horticulture, University of Maryland, College Park, Md., U.S.A.*

Although a large number of the species of *Rubus* throughout the world have been studied cytologically, the classification of these species and the many forms remains an enigma. Chromosome number in itself is of little use as a tool because of the frequent occurrence of individuals derived from reduced fertilized eggs, as well as from fertilized unreduced eggs. Chromosome morphology has proved not to be useful because of the small size of the chromosomes. In fact this small size has led to the publication of many inaccurate determinations of chromosome number.

There are few barriers to hybridization in the genus. Even wide crosses between the diploid raspberries and the tetraploid to 12-ploid blackberries are well known.

From controlled crosses (and presumably in the wild) there are produced many dwarf plants as well as unfruitful ones. The causes of the unfruitfulness are not yet understood. Aneuploidy is considered not to be a factor in the origin of dwarfs.

Mitotic instability is another cause of phenotypic variability in the genus. Phenotypic variablity is accentuated by the fact that *Rubus* canes are *biennial.* Accordingly, each year there is an opportunity for shoots to arise from genetically unstable tissues which were derived from split divisions in these mitotically unstable plants.

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Brooks, James S. An Experimental Re-examination of Mass Selection in Corn, *Zea mays* L. *Department of Agronomy, Oklahoma State University, Stillwater, Okla., U.S.A.*

In 1950 a selection experiment was initiated at Oklahoma Agricultural Experiment Station designed to supply information regarding selection procedure and to improve materials to be used in the corn breeding program.

Simultaneous selection was practised to reduce plant and ear height, to maintain the average number of nodes above and below the ear, to increase individual plant yield, to increase ear length, and to increase the average rows of grain per ear to 16 to 18 rows. Such selection was carried out on each of four open-pollinated varieties of corn during five years, using approximately 400 plants of each variety each year and selecting the ears from 20 plants for producing the next generation. Each variety was allowed to open pollinate in isolation. Records were kept on all measurements on each plant. Similar measurements were made on plants of the F_1 of a cross between two inbred lines and used as a check on environmental and seasonal variation. The selection differentials and selection progress have been determined for each year for the different characters.

Selection for reduced plant and ear height has resulted in greater height reduction than would be expected from the separate selection differentials. Node numbers have remained essentially constant during the reduction in height. The response to selection for 16–18 rows of grain per ear varied with the variety. Selection for increased ear length produced little apparent response. Selection for increased grain yield appeared to result in a decline in yield. This decline in yield in spite of a strong positive selection differential is interpreted as the result of inbreeding depression. Evidence that inbreeding has occurred during this form of mass selection was obtained by shifting to a pedigree form of progeny selection.

Brooks, Margaret H. A Comparative Study of the Patterns of Development in Certain Facultative Apomicts. *Department of Agronomy, Oklahoma State University, Stillwater, Okla., U.S.A.*

Investigations of some of the manifestations of apomixis were carried out in a study of the constitution and behaviour of the embryo sacs and pollen of two closely related genera, *Dichanthium* and *Bothriochloa*, belonging to the subtribe *Amphilastrae* of the *Andropogoneae*. Use of the Bradley (1948) smear technique facilitated a survey of the frequencies of the types of embryo sacs which occur in these materials. Three ploidy levels were represented, diploid ($2n = 20$), tetraploid ($2n = 40$), and hexaploid ($2n = 60$). The diploid *Dichanthium* which reproduces by sexual means contained only one sac per ovule, all sacs being of a single type (2 synergids, 1 egg, 2 polars and a group of antipodals). The accessions of higher ploidy level are to different degrees facultative apomicts, exhibiting multiple sacs per ovule, these sacs being of two principal types. One type of sac is similar to that found in the diploid, the other being a 4-nucleate type lacking one polar and the antipodals. Comparative studies indicated that the average number of sacs per ovule and the frequency of the 2 polar type sacs is as follows: *Dichanthium*: diploid contains 1.0 sac per ovule with 100% of 2-polar type; tetraploid, 1.7 sac per ovule with 28% of 2-polar type; hexaploid, 1.2 sac per ovule with 15% of 2-polar type. *Bothriochloa*: tetraploid contains 1.7 sac per ovule with 12% of 2-polar type; hexaploid, 2.0 sac per ovule with 9.7% of 2-polar type. Similarly, a comparative study was made of the synchronization of the female and male gametes, the data indicating a more perfect timing mechanism to be operative in the *Dichanthiums*, particularly in the diploid. The precocity of initiation of embryo development in the apomicts was compared with precocity of initiation of development in the endosperm in the sexually reproducing accession. The presence of multinucleoli in various nuclei, the sizes of embryo sacs, and the occurrence of polyspermy were found to be correlated with degrees of polyploidy. It appears from these data as well as from the breeding behaviour that the *Bothriochloas* tend more strongly towards obligate apomixis in several aspects than do the *Dichanthiums*, apomixis in the former presumably being of more ancient origin. However, the finding of potential sexuality in these materials which reproduce primarily or almost entirely by apomictic means presents challenges to the utilization of both environmental controls and culture methods to increase and exploit the inherent potential.

Brown, Meta S. The Implications of Pachytene and Metaphase Pairing for Species Differentiation. *Texas Agricultural Experiment Station, College Station, Tex., U.S.A.*

The genus *Gossypium* includes eighteen diploid species which fall into five genome groups on the basis of metaphase chromosome association and geographical distribution. Within a genome group, species differentiation is primarily genic, and metaphase association is reduced little if any from that within a species. In hybrids between species of different genome groups, metaphase association is greatly reduced, and sterility is complete. Nevertheless, pachytene pairing is as close in sterile hybrids with reduced metaphase association as in fertile hybrids with good metaphase pairing, and as in species. Either pachytene pairing in hybrids is no measure of structural differentiation of chromosomes, or factors other than structural differences are responsible for reduction in chiasma formation and metaphase association.

Chromosomes paired at pachytene are equal in length despite species differences in chromosome size at metaphase. Size differences are maintained autonomously in species hybrids and in aneuploids of hybrid origin. Chiasma formation likewise may be determined in each species by a mechanism analogous to that which controls chromosome size. This mechanism alone, in the absence of structural differences, may differentiate species by reducing metaphase association. Where structural differences can be demonstrated, they are not necessarily the primary factor in species differentiation.

BRYAN, JOHN H. D., and JOHN W. GOWAN. The Regenerative Response of the Mouse Testis to Two Different Levels of X-Irradiation (320 r and 2,560 r). *Department of Genetics, Iowa State College, Ames, Iowa, U.S.A.*

The pelvic regions of 58-day-old male mice of strains BALB/Gw and S were exposed to 320 or 2,560 r, the rest of the body being shielded. Animals were killed at 1, 8, 24 hours and at intervals up to 28 days after irradiation.

Except for dividing spermatogonia, exposure to 320 r induces little change in cellular composition until 1 to 3 days after irradiation during which time resting spermatogonia decline to less than 5% of control levels. Regeneration, apparent at 10 days, is well under way by 16 days. Dividing spermatogonia decline rapidly during the first 8 hours, increase slightly by 24 hours and decline further by 3 days. Later behaviour of the cells is essentially identical with that of interphasic spermatogonia. Spermatogonial necrosis is slightly increased following 320 r, the peak value of 2.4x control being reached at 8 hours.

Following 2,560 r, a significant decrease in frequency of resting spermatogonia is evident by 8 hours. By 5 days the level has declined to less than 10% of controls. Despite slight increases in frequency during the 5–10 day period no spermatogonia were present at 16 days. Dividing spermatogonia disappear rapidly during the first 24 hours and are absent at 5 days. No regeneration is evident at 16 days. Necrosis reaches a peak of 15% by 8 hours, but declines to zero by 24 hours. This is about 4 times the control level or almost twice the 320 r level.

These data support the conclusion that radiation-induced inhibition of chromosomal reduplication plays a prominent role in the initiation of the observed cellular changes. Also that radiation-induced cell death is more important at higher dosage levels. (This work has received assistance from Contract No. AT(11–1)107 from the Atomic Energy Commission.)

BUETTNER-JANUSCH, JOHN, S. J. BERHMANN, and F. P. THIEME. ABO(H) and Secretor Phenotypes and Human Fertility. *Laboratory of Physical Anthropology, University of Michigan, Ann Arbor, Mich., U.S.A.*

In recent years more and more evidence of the effect of the ABO(H) alleles on pregnancy outcome in certain types of matings has been presented. The secretor gene apparently controls the presence or absence of water-soluble ABO(H) antigens in the tissues, and the role of this gene in abortion and infertility is under investigation in several laboratories. McNeil and his co-workers, for example, presented data which bear on the problem of early abortion, ABO(H) incompatibility and the secretor gene. The present paper will be a summary of some studies of the ABO(H) and secretor alleles among couples who are apparently unable to conceive. A report of the following studies on such couples, deemed infertile for no apparent reason, will be presented: (1) the determination of the presence or absence of the ABO(H) antigens in the saliva; (2) the determination of the presence or absence of the ABO(H) antigens in the semen of the males; (3) the determination of the presence or absence of these antigens on the surface of spermatozoa.

A discussion of the data presented and the problem of hetero-specific ABO(H)-Secretor matings as a mechanism of natural selection against certain ABO(H) phenotypes concludes the paper. (These studies were supported, in part, by USPHS grant H-3098, and by a grant from the Josiah Macy Foundation.)

BURDICK, ALLAN B., and TERUMI MUKAI. Experimental Consideration of the Heterozygous Genetic Effect of Low Doses of Irradiation on Viability in *Drosophila melanogaster. Department of Biological Sciences, Purdue University, Lafayette, Indiana, U.S.A.*

There is much evidence to indicate that the homozygous state of most irradiation-induced mutations is deleterious with respect to viability. However, in random mating populations, the homozygous state of a deleterious mutation is not achieved very frequently unless the heterozygous state is associated with higher-than-normal viability. In addition, most of the deleterious alleles of a gene in a random mating population will exist in heterozygous condition. Therefore, in determining the genetic effect of irradiation on random mating populations, it is much more important to determine the heterozygous mutant effects since most of the population consequence will be manifest from this condition.

Using a CMI-produced homozygous line of *Drosophila melanogaster*, we irradiated sperm with 0, 75, 150, and 300r and CMI-extracted about 80 homozygous lines per treatment. These experimental lines were then crossed to the original line to produce irradiation heterozygotes which were allowed to compete with homozygotes of the original line.

The most significant observation made was that the genetic variances of all of the irradiated groups were highly significantly greater than those of the control, the comparison for the 75r group being 96 versus 265. The variance increase of experimental groups was homogeneous, that is, not marked by few discrete viability differences, but by many small differences.

These mutations are dominant in the sense that they produce a phenotypic effect in heterozygous condition. The large variance increases produced by these low doses of irradiation indicate that a great many more mutations were produced than would be expected from present estimates of the number of potentially mutable genes and their average mutation rate per roentgen unit. The mutations produced appear to be equally likely to increase or decrease viability when in heterozygous condition.

BURDICK, ALLAN B. *See* MUKAI, TERUMI.

Burnham, C. R., E. Turcotte, and P. Yagyu. Interchanges Involving Three Chromosomes in Barley. *Institute of Agriculture, University of Minnesota, St. Paul, Minn., U.S.A.*

Among the intercrosses between the tester set of interchanges and unknowns there were two instances with a ⊙8. When first established, these unknowns had a ⊙4. In the test crosses of both parents, that with the unknown had a ⊙6, that with the other had a ⊙4. Test crosses have established one unknown as having chromosomes a, c, d interchanged.

The F_2 progeny of one of the intercrosses with a ⊙8 included 20 plants with a ⊙8, 9 with 7II and one with a ⊙4. The latter is a possible crossover in a differential segment.

Burton, Glenn W. Genetic Variances in Pearl Millet (*Pennisetum glaucum*) and Their Significance to the Forage Breeder. *U.S. Department of Agriculture, Georgia Coastal Plain Experiment Station, Tifton, Ga., U.S.A.*

Since 1937, the U.S. Department of Agriculture and the Georgia Coastal Plain Experiment Station have been actively engaged at Tifton, Georgia, in the genetic improvement of Pearl millet, the most important annual pasture and forage grass in the southeastern United States. The protogenous flowering habit of this species has facilitated a breeding program similar in many respects to that followed by U.S. corn breeders. The development and evaluation of inbred lines from local and introduced varieties have been continued throughout the program.

Over the past ten years, 674 Pearl millet singlecrosses involving 248 well-established inbred lines have been compared in 15 forage yield tests designed to permit the estimation of additive and non-additive genetic variances. Some sets of inbreds have exhibited little non-additive variance. In other sets, most of the genetic variance has been of the non-additive type. On the average, 54.25 per cent of the total genetic variance for forage yield has been non-additive. These results indicate that: (1) Some increase in forage yield should result from the use of straight selection methods, (2) the maximum yield advance will be dependent upon the commercial use of the F_1 hybrid, and (3) tester crosses should be superior to topcrosses in evaluating new inbred lines.

Gahi-1, developed by using the procedures listed above, is an F_1 hybrid officially released for farm use in February 1958. In Regional Tests, it has outyielded the common check by as much as 50%.

Buss, Keen. *See* Wright, James E.

Butler, Leonard. Heterogeneity of Recombination Values in the Tomato. *Department of Zoology, University of Toronto, Toronto, Canada.*

Conflicting reports in the literature of recombination values that differ by as much as 15 ± 2%, has led to the investigation of the effect of the following factors on crossing over: differential germination, misclassification because of genic interaction, genotypic background, coupling versus the repulsion phase, age of seed, temperatures during F_2 seed formation, and acidity of the soil in which F_1 plants are grown. In most cases where the recombination data are derived from more than five plantings, significant heterogeneity is shown. Differential germination accounts for most of the heterogeneity for crosses involving the genes *Xa*, *Wo*, *ro*, *rv* and *yv*. Misclassification of some genic combinations of *d*, *nc*, *br*, *dv*, *s*, *bk*, *tf*, and *H*, also account for some heterogeneity. Suggestive findings indicate that the recombination values of *wt* are influenced by the genetic background. Elimination of all other factors left no clear evidence that coupling data give different values from recombination data. Age of seed had some effect through its association with differential germination. The following data indicate that an environmental factor, probably temperature, has a major effect on recombination as shown by these values for different plantings of the same cross: 2,792 plants from seed grown in winter greenhouse gave 27.7 ± 1.72%, 1,755 plants from seed grown in the field gave 18.1 ± 2.29%, 1,565 plants from seed grown in summer greenhouse gave 11.3 ± 2.49%. Preliminary results indicate that recombination values are higher when F_1 plants are grown in acid soil. These findings indicate that data for linkage should not be indiscriminately combined, but should first be checked for heterogeneity.

CALEF, ENRICO. Integrated Genetics of Lambda Prophage and Coli K12. *Istituto di Genetica, Universita di Pavia, Pavia, Italy.*

The prophage genome is known to be attached to the genome of the bacterial host. Crosses between K12 derivatives, carrying marked lambda prophages, were carried out to find out more about the relationships of the two genomes.

Two types of crosses were attempted; the first type making use of Hfr1 and Hf2. Among the progenies selection was made for prototroph Gal + recombinants. Hfr1 on Hfr2 in these crosses gave the same type of results. The data might be summarized as follows: The determinants of the prophage are linked to the Gal locus in the following order: St. . . . . h co Gal Hfr1 T6. The test of linearity on these data shows apparent excess of exchange between St and h; the rate of exchange in that region ranging from 70 to 84%. This feature might be explained as the result of the recombination in incomplete zygotes. It is possible to test this explanation selecting St^r from the donor or some other marker linked to it. This new type of selection also requires the use of two pseudo-alleles Gal— and a donor Met— .The recombinants were selected to carry the following characteristics Met + from the F—; St^r from the Hfr, Gal + 54–2 for F— and Gal + 32–2 from the Hfr.

The preliminary results are promising in so far as they show no "recombination fraction" higher than 50%.

Owing to the peculiarity of the K12 mating system, this type of selection is somewhat inconvenient. Indeed, the conditions suitable for selection of St^r from Hfr favor reiterated mating. We are, therefore, studying a new Hfr able to transfer this particular region at high frequency and crosses in which Arginine + is selected from the Hfr instead of St^r.

CÂMARA, A., D. CASTRO, and M. NORONNA-WAGNER. Cytogenetics of Accessory Chromosomes in *Luzula campestris* DC. *Estação Agronomica Nacional, Sacavem, Portugal.*

Meiotic behaviour and inheritance of the accessory chromosomes have been studied in *Luzula campestris* DC. Results of selfed plants with one accessory chromosome as well as inheritance in reciprocal crosses, involving a plant with one accessory chromosome and a plant without accessories, are presented.

Accessory pairing in plants with two accessory chromosomes and their segregation to tetrads of pollen grains were studied.

CAMERON, DONALD R. Alien Substitution of a Locus Effecting Immunity to Blackshank in *Nicotiana tabacum. Department of Genetics, University of California, Berkeley, Calif., U.S.A.*

To maintain adequate fertility, sesquidiploid hybrids between *N. tabacum* and *N. plumbaginifolia* (*tbc-tbc-pbg*) and backcross derivatives were used in transferring a segment of *pbg* chromosome to a commercial type of *N. tabacum.* Backcrossing to diploid *N. tabacum* accompanied by selection for immunity leads rapidly to the establishment of a $24''+1'$ condition. Such plants proved to be 85 per cent pollen sterile and high male transmission of the *pbg* chromosome showed that 25 chromosome pollen grains were functioning almost exclusively. The factor responsible for pollen abortion was separated from the dominant Blackshank locus (*Bs*) in three lines, two of which involved fragment chromosomes. The other included a fertile plant with the constitution $23''+3$, the trivalent indicating that an exchange between *tbc* and *pbg* chromosomes had occurred. On selfing, populations were obtained exhibiting full immunity to the disease. Transmission percentages of about 40, 50 and 78, for ovule, pollen and selfing respectively, were in fair agreement with expectation if segmental substitution had been achieved. The corresponding transmission rates in $24''+1'$ lines were roughly 9, 92 and 89%. Incorporation of other dominant genes from *pbg* has resulted in variegation in each instance. Even after the $24''$ condition was reached progenies continued to segregate. The precise mechanism of this instability is as yet unknown. The low female transmission of the *Bs* chromosome in $24''$ lines and the observed segregation from plants heterozygous for the *Bs* locus suggest that isolation of a satisfactory introgression product by this method may be more difficult than expected.

CAMERON, J. W., and D. COLE. Use of the Genes su_2 and *du* to Reduce Starchiness during Ontogeny in the Maize Kernel. *University of California Citrus Experiment Station, Riverside, Calif., U.S.A.*

In developing kernels, the recessive gene su_1 conditions occurrence of more sugar, less starch and much more water-soluble polysaccharide (WSP) than occur in the presence of its normal allel Su_1. Certain other genes, i.e., bt_1 and bt_2, also reduce starch and increase sugar, but do not cause an accumulation of WSP. The separate effects of the genes su_2 and *du* have been measured in several inbred backgrounds in which su_1 is also homozygous. The most consistent effect of each gene is to slow the accumulation of starch, often beginning at 16 days after pollination or earlier. Starch was from 25 to 50% lower in homozygous su_1 su_2 and su_1 *du* than in su_1 on 6 tested backgrounds at 16 to 22 days. On 2 backgrounds there was no apparent difference among genetypes at 16 and 19 days. Absolute differences in starch were relatively independent of dry weight per kernel, within inbreds. Sugar and WSP content were not consistently different among the 3 genotypes, but increased tenderness and a less starchy taste were characteristic especially of su_1 su_2. Other changes in carbohydrate characteristics, such as the amylose-amylopectin ratio or the nature of the WSP fraction, may contribute to the difference in taste. Preliminary assays indicated little difference in rate of change of sugars and WSP during storage of kernels on the cob, but percentage increase in starch was usually lower in su_1 su_2 and su_1 *du* than in su_1. Incidence of mold on mature ears of su_1 su_2 and su_1 *du* was not significantly greater than on su_1 ears unless earworm had been present.

Campbell, A. B. *See* McGinnis, R. C.

Campbell, Ian. An Analysis of the Genetic Determination of Egg Weight in the Genus *Choristoneura* Led. (Lepidoptera: Tortricidae). *Forest Insect Laboratory, Sault Ste. Marie, Ontario, Canada.*

The genetic determination of egg weight in the genus *Choristoneura* was analysed on the basis of the egg weights of two geographic races of *C. fumiferana* Clem. (the eastern spruce budworm (B) and the western one-year-cycle spruce budworm (D)), the jack-pine budworm, *C. pinus* Free. (J), and their reciprocal F_1 hybrids. The differences between the egg weights of these different groups reflected genetic differences that were transmitted autosomally and x-chromosomally, as shown by the characteristic differences between reciprocal crosses. By measuring the differences between the egg weights of each parental type and all possible F_1 combinations, where the genetic constituent is fully known, it was possible to characterize the genetic effects of each specific x-chromosome and set of autosomes.

The results of this analysis indicated that the genetic units which determine egg weight act by controlling the rate of metabolic processes involved in egg growth, and that each unit acted by raising the rate of these processes by a specific power. The numerical value of effective genetic units on the autosomes of B, D, and J were 4, 10, and 5, and on the x-chromosomes, 22, 12, and 0 respectively.

Capinpin, José, M., and Udhai Chanphaka. Mutagenic Effects of Phytoextracts from *Antiaris toxicaria* (Pers.) Lesch and *Dioscorea hispida* Dennst. upon Living Plant Tissue. *College of Agriculture and Central Experiment Station, University of the Philippines, Los Baños, Laguna, Philippines.*

Previous studies on Philippine species of poisonous plants (Capinpin *et al.*, 1944, 1949, 1953) have shown that extracts from the bark of arrow-poison plant, *Lophopetalum toxicum* Loher, and root extract from a dog-poison plant, *Rourea erecta* (Blanco), Merr., were polyploidizing or growth-inhibiting or growth-promoting agents. The present investigation deals with the action of the phytoextracts from *Antiaris toxicaria* (Pers.) Lesch, a source of powerful heart poison, and *Dioscorea hispida* Dennst., a source of arrow or spear poison, on living plant tissue.

The extracts were prepared in a specific manner so that the effectiveness of the toxic derivatives in the extracts simulates their quality as they occur in nature. These two extracts were tried at various concentrations on the plant testers, viz. root tips of onion (*Allium cepa* L.), seeds of mungo (*Phaseolus aureus* Roxb.), and seeds of soybean (*Glycine max* (L.) Merr.).

The extract from *Antiaris toxicaria* at one-half concentration (one part of the extract to one part water) and at one-fourth concentration (one part of the extract to three parts water) caused c-tumours in root-tips of onion when soaked for four hours and eight hours, respectively. The germinative ability of soybean and mungo seeds was delayed and sometimes inhibited if the periods of soaking were prolonged. C-mitotic figures in the cells of root-tips of onion occurred when treated with a right concentration and for a certain period of time.

C-mitotic figures were observed in the cells of root-tips of onion (at one-half concentration), similar to those produced by the extract from *Antiaris toxicaria* of the same concentration.

The results of the experiment appear to bring to light two naturally occurring substances capable of inducing cellular abnormalities and observable developmental variations.

CARLSON, ELOF AXEL. Some Problems Involving the Cis-trans Effect in *Drosophila. Indiana University, Bloomington, Ind., U.S.A.*

In the dumpy (dp) series of *Drosophila melanogaster*, four subloci are demonstrable by crossover tests involving outside markers and two others are suggested by differences in crossover frequencies. Omitting the gene-nest symbol dp, the indicated sequence is ′ol ′olv ′o ′lv ′ov ′v, where o, l, and v, respectively, denote the production of “oblique” wings, recessive lethality, and thoracic vortices. In heterozygotes, those mutant phenotypes (o, l, or v) are expressed which have genetic elements for them present in both chromosomes. Thus the *trans* heterozygote ′o/′lv is wild type, despite nearness of these subloci, whereas, ′ov/′ol and ′ov/′olv show very strong mutant phenotypes, although involving more distant subloci. The *cis-trans* effect of the pseudoalleles in the nest is just as extreme for the o, l, and v effects as the effect expressed in true homozygous alleles. Certain position effects can be shown in the nest by means of the specific modifier, Moiré. All members of the nest except ′v, show an oblique effect in the heterozygote when Moiré is present. No phenotypic difference is seen between the *cis* and *trans* arrangement of ′o and ′v or of ′ol and ′v. In the *trans* state however, ′o and ′lv (which are near together) show a more extreme effect in the wing than in the *cis* state. Heterochromatic position effects, found in rearrangements having one break near, or perhaps in, the dumpy-nest and one in heterochromatin, show “variegated” expression of the o and v effects and are suppressed by extra heterochromatin, which suggests a spreading effect throughout the nest. It is believed that a reinterpretation of the mechanism of the *cis-trans* effect is needed.

(This work was supported by pre-doctoral fellowships from the NSF (1955–56) and NIH (1956–57) and by a grant to Dr. H. J. Muller and associates from the U.S. Atomic Energy Commission, Contract AT (11–1)–195.)

CARSON, GWENETH L., and GERALD BRAVER. Studies of the Spouse Effect on Spontaneous and X-Ray Induced Lethal Mutations in *Drosophila melanogaster*. *Department of Zoology and Radiation Laboratory, University of California, Berkeley, Calif., U.S.A.*

Hildreth and Carson (1957) have shown that the frequency of spontaneous lethals in X-chromosomes derived from wild-type males was influenced by the type of female (Basc or Bv) that had been inseminated. This phenomenon, called the "spouse effect," is presently being studied along the following lines. (1) To determine if differences in the genetic backgrounds of the males examined for lethality were involved in the spouse effect, the genetic background of the Hildreth and Carson Bv (high mutation frequency line) lethals was replaced by one closely corresponding to that of the Basc (low frequency) lethals. If some of the Bv X-chromosomes were classified as lethal because of interaction with the remainder of the Bv genotype, but would not have been classified as lethal had they occurred in crosses with Basc, this test might result in reverted, non-lethal, wild-type males. At this writing, 31 of the 32 Bv lethals have been tested; all remain lethal in the Basc background. These differences, then, appear to be eliminated as a major component of the spouse effect. (2) Tests were made for the presence of a spouse effect on X-ray induced X-chromosome lethal mutations, using the Basc and Bv lines that had been utilized in the original investigation of spontaneous lethals. No clear-cut spouse effect could be demonstrated. (3) In order to study this problem further, a new experimental design is being used. The X-chromosomes of males coming from a highly inbred line are being tested for spontaneous and X-ray induced lethal mutations concurrently. One type of male and three types of females differing in genic and chromosomal constitution are being used. (This work was performed under the auspices of the Atomic Energy Commission.)

CARR, A. J. H. *See* OLIVE, LINDSAY S.

CARSON, HAMPTON L. Increase of Fitness in Experimental Populations following Introduction of One Haploid Set of Autosomes. *Washington University, St. Louis, Missouri, U.S.A.*

Four closed populations of the multiple third chromosome stock se ss k e^s ro of *Drosophila melanogaster* were allowed to rise to an approximately equilibrated size in small population chambers (Carson, Rec. Gen. Soc. Amer. *26*: 363). Food, temperature, light and space were kept constant. The upper asymptote of the postulated logistic curve is replaced by relatively minor oscillations of population size. After achievement of approximately stable age-distribution and sustained equilibrium size, one foreign adult male fly was introduced into each of two of the populations. The other two populations were continued as controls. The two males were siblings and were F_1s from a cross of a se ss k e^s ro female from the population by a + male (Oregon R). The foreign genetic material introduced into each population, therefore, consisted of one haploid set of + autosomes, in addition to a Y-chromosome, from the Oregon stock. The frequency of the wild-type phenotype increased with dramatic suddenness in three generations to about 90% in both of the experimental populations. Free recombination of the third chromosome genes is observed. Concomitant with this change, the population size (in mg. wet weight) is approximately doubled. The biomass produced (wet weight of hatching adults/week) also abruptly rises. Data obtained to date indicate that both of these new attributes are maintained in the experimentals; the rise in fitness, therefore, appears to be permanent. In several pilot experiments, none of the mutant genes (se ss ro only in this case) has been completely eliminated by natural selection, even several years after return to mass culture. This fact, in addition to the initial speed of the change, suggests that the increased fitness is due to heterosis.

CASE, MARY E. Linear Relationships of Allelic Mutants at the *Pan-2* Locus in *Neurospora crassa. Botany Department, Yale University, New Haven, Conn., U.S.A.*

A new group of 37 allelic, pantothenic acid-requiring mutants at the *pan-2* locus in *Neurospora crassa* have been located in linkage group VI and show the following order and crossover values with markers in that group: *ylo* 1.7 *ad-1* 0.2 centromere 1.7 *pan-2* 7.7 *tryp-2*. Nine of these mutants, although blocked in the same step in pantothenic acid synthesis—the conversion of keto-valine to keto-pantoic acid—complement in certain combinations to form pantothenic acid-independent heterocaryons. These results provide evidence for two distinct functional units at the *pan-2* locus. An extensive tetrad analysis from a marked cross between two of these complementing mutants (*B5* and *B3*) indicates that the two functional units can also be separated genetically since asci have been obtained containing a pan prototroph of one cross-over type and a double mutant (*B5 B3*) of the reciprocal cross-over type. The composition of certain other asci indicates that mechanisms other than conventional crossing-over are probably also involved in the origin of some prototrophs. Despite this fact, the relative frequencies in the two possible cross-over categories of pan prototrophs from random ascospore platings of *B5* × *B3* establish an order of the mutants in agreement with the results from tetrad analysis, *B5* being proximal to *B3*. Similar random ascospore platings from crosses of all the remaining mutants to *B3* and *B5* indicate that non-complementing as well as complementing mutants can be grouped with either *B5* or *B3* on the basis of both the absolute frequencies of pan prototrophs and their relative distributions in the two cross-over categories. Additional crosses between single pan mutants, as well as crosses of single with double mutants indicate that recombination also occurs between mutants within each of the two groups. These data provide evidence for a linear relationship of mutants within each group. (Supported in part under a contract AT(30–1)–872 with the U.S. Atomic Energy Commission.)

CASPAR, ALAN L. *See* SINGLETON, W. RALPH.

CASPARI, ERNST. The Genic Control of Riboflavin in the Testis of *Ephestia. Wesleyan University, Middletown, Conn., U.S.A.*

In the testis sheath of wild-type *Ephestia,* a yellow pigment appears in the prepupa which has been identified as riboflavin. It can be determined micro-biologically. The riboflavin content of the testis reaches a plateau in the early pupa, amounting to over 50% of the total riboflavin, and drops in the late pupa, the riboflavin being transferred to the Malpighian tubules.

The gene *a* causes an increased level of riboflavin at the plateau and an earlier drop than a^+. The gene *wa* inhibits the appearance of riboflavin in the testis sheath at any time. Three possible mechanisms for the inhibition of testis riboflavin by the gene *wa* were considered: (1) inability to synthesize riboflavin; (2) inability to accumulate riboflavin in the testis; (3) destruction of riboflavin. The larva stops feeding in the middle of the last larval instar. If riboflavin was synthesized at the time of its appearance in the testis, an increase in the total riboflavin in wa^+ prepupae would be expected. Total riboflavin increases in both wa^+ and *wa* animals during the first half of the last larval period, and reaches its highest level in the early prepupa, i.e. before the accumulation in the testis is completed. The total riboflavin content of *wa* animals is at all times significantly lower than that of wa^+ animals. If *wa* testes are transplanted into wa^+ larvae, they do not accumulate riboflavin.

These results exclude possibility (1) since they suggest that no riboflavin is synthesized in wa^+ animals during the time when it appears in the testis sheath. Possibility (2) seems unlikely since in this case the riboflavin content of *wa* animals would be expected to equal that of wa^+ animals without being accumulated in the testis. The evidence is compatible with possibility (3) though additional hypotheses cannot be discounted. (Supported by National Science Foundation Grant G4495.)

CASTIGLIONI, M. C. The Behaviour of the Lymph Gland and the Migrant Haemolymph Cells, in Different Genotypes of *Drosophila melanogaster. Istituto di Genetica, Università di Milano, Milan, Italy.*

The morphology and the structure of the lymph gland have been studied during the third instar of *Drosophila melanogaster*, and differences have been found, which seem to be controlled by all three major chromosome pairs. The migrant cells of the haemolymph have been also investigated, and found classifiable into four types. The frequency of these cell types is also controlled by the genotype. A peculiar type of large cell proves to be the only one capable of producing melanin, after undergoing morphological changes: melanization (bringing about the production of melanotic masses) is controlled by recessive genes (tu) located—in the stocks investigated so far—in the second chromosome.

These findings contribute to the knowledge of the genotypic control of cell differentiation.

CASTRO, D. *See* CÂMARA, A.

CASTRO, L. E. *See* CAVALCANTI, A. G. LAGDEN, *et al.*

Cavalcanti, A. G. Lagden, D. N. Falcao, and L. E. Castro. The Interaction of Nuclear and Cytoplasmic Factors in the Inheritance of the "Sex-Ratio" Character in *Drosophila prosaltans. Centro de Pesquisas de Genetica, Universidade do Brasil, Rio de Janeiro, Brazil.*

The paper reports a phenomenon of "sex-ratio" in *Drosophila prosaltans.* This condition is found in natural populations and is evidenced by the existence of special females which give rise to exclusively or mainly female progenies.

A working hypothesis is presented, interpreting the results as due to an interaction between nuclear genes and cytoplasmic factors: *SR*—"sex-ratio" gene for unisexual female progenies; *sr*—recessive allele causing the appearance of males; *o′* (omikron)—plasmagenes necessary for the "sex-ratio" action. The "sex-ratio" females carry the plasmagenes omikron. The absence of males in their progenies is due to the death of the *XY* zygotes with an omikron plasmon. Normal males and females do not have the plasmagene. It is transmitted maternally. The reproduction of the plasmagene occurs only in the presence of the *SR* gene. In recessive homozygotes *sr/sr* the plasmagene stops its multiplication and gets lost. The only known function of the gene *SR* is to permit the reproduction of the plasmagene. It does not have any visible effects either in sex-ratio or in non-sex-ratio flies. The inbreeding of normal flies leads to the establishment of two kinds of homozygous stocks: the sex-ratio maintainer stocks *SR/SR* and the sex-ratio disrupter stocks *sr/sr.* The authors tested the hypothesis by backcrossing for two consecutive generations sex-ratio females homozygous for the *SR* gene to males of these two kinds of stocks. In the first case, only female progenies must hatch in both generations; in the second only females in F_1 and males and females in F_2 and subsequent generations. The results fully confirmed the expectation. The authors make a comparison between the "sex-ratio" trait in *Drosophila* and the "killer" character in *Paramecium,* pointing out the remarkable parallelism.

(This work was performed with funds of the Conselho Nacional de Pesquisas, Universidade do Brasil and the Rockefeller Foundation.)

Chai, Chen K. Isolation of Genetic Factors Affecting Body Size in Mice. *Roscoe B. Jackson Memorial Laboratory, Bar Harbor, Maine, U.S.A.*

A crossbreeding experiment using Large (mean body weight 36.6 gm.) and Small (mean body weight 14.6 gm.) strains of mice to produce F_1, F_2 and several backcross generations has been carried out. Results based on the earlier generations have indicated segregation of genetic factors responsible for difference in body size between these two strains and some degree of dominance of plus factors over minus factors. A minimum of 13 segregating units was estimated. In an attempt to isolate these units, repeated backcrossing to the Large and Small mice along with mass selection for large and small body size has been continued. Selection began at the second reciprocal backcross generations. The Large mice have a slower turn-over rate in reproduction and the backcrossing to the Large is at the fourth and fifth generations, while backcrossing to the Small mice has completed the sixth generation. Only the results of the Small mice and the backcrosses to the Small are given at present, using 60-day body weight as the index of body size, and including a total of 1,816 mice.

The Small mice produced during the years 1953 and 1954 were contemporary with the F_1 and the first backcross (B_{1S}) generations, in the years 1955 and 1956 with B_{2S}, B_{3S} and B_{4S}, and in the year 1957 with B_{5S} and B_{6S}. The mean body weights and variances within litters of the Small mice and the backcrosses will be presented. Beginning from the fourth generation the backcrosses selected for large body size showed no more reduction in mean body weight and those selected for small body size approached the mean weight of the Small strain. The variances were in general as expected except those of $B_5S(L)$ and $B_6S(L)$ which appeared smaller than expected.

There was a slight increase in body size of the Small mice. The Large mice do not have minus factors which are not present in the Small mice. It is likely that single factor has been isolated in the $B_{4s}(L)$ to $B_{6s}(L)$ generations, which causes an increment of body weight of the Small mice by approximately one gram. If more than one plus factor have been introduced from the Large to the Small mice, only one of them would be present in any individual mouse of these generations. (Aided by grant C-3108 from the National Cancer Institute of NIH, U.S.A.)

CHANPHAKA, UDHAI. *See* CANINPIN, JOSÉ M.

CHASE, SHERRET, S. The Utilization of Parthenogenesis in Maize Breeding. *DeKalb Agricultural Association, Inc., DeKalb, Ill., U.S.A.*

During the past few years several thousand parthenogenetically derived monoploid maize plants have been isolated. From these plants, through self-pollinations of the occasional, partially fertile individuals several hundred homozygous diploid progeny have been developed. In tests of these as parents of commercial type hybrids, a high percentage have proven to be superior in performance. This result has encouraged the continued use of the "monoploid method" as a practical tool for maize breeding.

CHENNAVEERAIAH, M. S. *Campelia zanonia*: Is It a Polyploid? *Institut Botanique, Montreal, Canada.*

The role of polyploidy as a potent factor in the evolution of plant species, especially among the flowering plants, is well known. It is true that up to 30–35% of the Angiosperms are polyploids and there is a growing tendency among botanists to list more and more of these as polyploids of one kind or the other. The Tradescantias alone are known to include auto-, allo-, aneu- and segmental-polyploids. The question is whether *Campelia zanonia* (L.) H.B.K., a monotypic genus of the tribe Tradescantieae-Hexandrae with chromosome number $2n = 16$, suggested to be a tetraploid with basic chromosome number of 4 (Darlington, J. Genetics *35*: 259–280), is a polyploid at all. This suggestion of Darlington is based on the observations of Anderson and Sax (Bot. Gaz. *97*: 433–476) who reported associations of 4 at meiosis.

Since *Campelia zanonia* is being grown at the Montreal Botanical Gardens, it was thought worthwhile to investigate its suspected polyploid nature. If it is a polyploid, it should be an autotetraploid as it is monotypic. Autopolyploids in nature, however, are very rare except for plants such as *Galax aphylla* which is an autotetraploid (Baldwin, J. Heredity *32*: 249–254) and *Tradescantia bracteata* which is an autotriploid (King, J. Heredity *24*: 253–256).

Karyomorphological studies performed on *Campelia zanonia* reveal that there are only two genomic sets of chromosomes.

Configurations of meiotic chromosomes in a hundred or more microspore mother cells showed complete absence of multivalents. The association of four observed by Anderson and Sax was probably due to overlapping and the mention of four bivalents in it may be a misprint. Since no taxon of *Campelia zanonia* with chromosomes $2n = 8$ has been discovered (as was found by Baldwin in *Galax aphylla,* diploid with $2n = 12$ and tetraploid with $2n = 24$ chromosomes), and since the present cytological studies reveal only two genomic sets of chromosomes and the absence of multivalent formation, *Campelia zanonia* ($2n = 16$) should be regarded only as a diploid on the criterion of chromosome number.

CHILDERS, W. R. A Case of Complete Male Sterility in *Medicago sativa* L. *Forage Crops Division, Central Experimental Farm, Ottawa, Canada.*

A completely male sterile plant of *Medicago falcata* × *M. sativa* origin was obtained from Dr. V. C. Brink of the University of British Columbia. A cross was made with a male fertile plant and cytological and genetic studies were made of the male sterile condition.

The course of microsporogenesis of the male sterile plant was regular until after the tetrads of spores were formed. Then rapid degeneration of the developing spores occurred, a condition which was accompanied by the appearance of extremely dense, swollen tapetal tissue. No mature pollen grains were observed. In the F_1 generation all variates were male fertile. When F_2 and backcross families were grown and observed, 63:1 and 15:1 ratios of fertile-sterile variates were obtained in the former and 7:1 and 3:1 ratios in the latter families. Thirty-four F_2 plants, selected from a population segregating 15:1 for the male-fertile and male-sterile characters, were selfed. F_3 families were grown out and observed for male fertility. These families were grouped into three classes, non-segregating, segregating 15:1 and segregating 3:1 in a proportion of 7:4:4 respectively. These results supported the 15:1 ratio obtained in the F_2 family. Considering the F_2 and F_3 results, it was concluded that complete male sterility was determined by three recessive genes. The symbols proposed for these genes were *ms*3, *ms*4 and *ms*5.

CHOVNICK, A. Structural and Functional Aspects of Pseudoallelism in *Drosophila melanogaster*. *University of Connecticut, Storrs, Conn., U.S.A.*

Recombination studies are reported between garnet mutants of *Drosophila melanogaster* (chromosome 1–44.4) in both free-x and attached-x heterozygous females. The pattern of recombination for closely linked markers in association with the recovery of non-garnet chromosomes from mutant heterozygotes is consistent with a pseudoallelic organization in the order g^2 — g^{50e} — (g^3,g). The estimated recombination frequencies indicate that garnet is the tightest cluster of mutants thus far to yield to recombination in this organism. The linkage distances permit an estimate of the resolving power of recombination analysis in *Drosophila*. In addition to the recovery of non-garnet chromosomes associated with recombinations between the closely linked markers, there were recovered, from several heterozygous combinations, non-garnet chromosomes not associated with marker recombination. Further investigations reveal that (1) these "reversions" produce a phenotype indistinguishable from wild type; (2) the origin of the "reversions" does not involve suppressor mutation; (3) spontaneous reverse mutation is not the mode of origin of the "reversions."

The relationship between the results of this study, and the results obtained with reddish-alpha in *Drosophila virilis,* and cases of gene conversion seen in microorganisms, will be discussed.

CHOWN, BRUCE. *See* LEWIS, MARION.

CHU, ERNEST H. Y., and NORMAN H. GILES. Chromosome Complements and Nucleoli in Normal Human Somatic Cells in Culture. *Botany Department, Yale University, New Haven, Conn., U.S.A.*

Cytological studies have been made on human somatic cells in cultures derived from explantation of six surgical biopsies and of two fetuses (all from American Whites). In all eight individuals the diploid chromosome number was 46. In one human embryo the same number was found in cells from seven different organs. In another individual squash preparations of primary spermatocytes showed the same diploid number as testicular fibroblasts *in vitro.*

Detailed idiograms based on normal diploid cells *in vitro* from different human individuals have been constructed. By chromosome matching, the human Y-chromosome has been recognized. Further studies confirm and extend the observation by Tjio and Levan (1956) of satellites on human chromosomes and indicate that there are two pairs of homologues with satellites, both having submedian centromeres. One of these chromosomes is short (about 2μ) and the other medium (about 4μ) in length. In each chromosome, the satellite is located on the shorter arm.

Our studies also indicate that the human somatic interphase nucleus contains basically four spherical nucleoli which are in fact two pairs with approximate diameters of 1 and 2μ respectively. In certain cells, these four nucleoli are found to have fused into three, two or one units. All of the nine possible fusion patterns with the expected nucleolar volume relationships are found. The relationship between the satellited chromosomes and the number and structure of nucleoli will be discussed.

(Supported in part under a contract AT(30-1)-1908 with the U.S. Atomic Energy Commission.)

CHUNG, C. S., and N. E. MORTON. Discrimination of Genetic Entities in Muscular Dystrophy. *Department of Medical Genetics, University of Wisconsin, Madison, Wis., U.S.A.*

A study was made to separate genetic groups of muscular dystrophy by discriminant functions. Approximately 800 cases from Wisconsin and from comparable studies in the literature were classified on pedigree information into four non-overlapping groups: I, an affected parent; II, not I, but an affected girl in family; III, not I or II, but a maternal male relative affected; IV, not I, II, or III, only brothers affected. Twenty variables associated with mode of onset and clinical condition were used for the initial discrimination, with the addition of laboratory data and muscle function evaluations for the Wisconsin material.

The first three groups are differentiated by parental consanguinity, localization of first symptoms, pseudohypertrophy of calves, and course of the disease. When the relevant variables are combined into discriminant functions, there is good separation of I and III, but appreciable overlap between I and II and between II and III. Isolated probands of class II have significantly less parental consanguinity and higher average of age onset than familial probands. The data suggest that about 60% of class II cases are attributable to autosomal recessive genes and the remainder are sporadics of uncertain origin. No clinical difference was observed between sexes of familial cases of class II, whereas in class I the males have significantly later age of onset than females.

Using the discriminant between II and III, class IV shows a bimodal distribution, the modes of which approximate those of groups II and III. The discriminant permits phenotypic classification of IV cases into probably of genetic type II or probably of genetic type III, with a calculated error of about 15%.

Further investigations by the discriminant methods of Bartlett will be reported, together with linkage studies and evidence on the value of muscle function evaluations and laboratory tests in group discrimination. High levels of serum aldolase and transaminase are characteristic of sex-linked cases.

CHUNG, C. S. *See* MORTON, N. E.

CLARK, GORDON MURRAY. Chromatographic Studies on X-Radiated Protozoa and the Medium on which they have been growing. *Department of Zoology, University of Toronto, Toronto, Canada.*

The ciliate *Tetrahymena pyriformis* grows on a defined medium consisting of various amino acids, vitamins, nucleic acids, salts, etc. Strains TC 89, TC 105, TC 110, and TC 148 (variety nine) were X-radiated at dosages of 100,000 r to 600,000 r at 100,000 r intervals (5,000 r per minute at 25°C). The ciliate was washed in doubly distilled water and starved 24 hr. previous to irradiation. After irradiation approximately 25,000 organisms were placed in 5 cc. of defined medium and allowed to grow for 120 hours at 25°C (slanted tubes). Irradiated and non-irradiated organisms were also placed on 5 cc. distilled water for a period of 72 hours. Following the incubation period, samples of media and distilled water (0.05 cc.), with the ciliates removed were placed on chromatographic (What-man #1) and a 30 × 30 cm. two-dimensional chromatogram was run using 80% aqueous phenol and butanol-acetic acids as solvents. A 0.2% solution of ninhydrin in water-saturated n-butanol was used as a developer. Studies with irradiated ciliates placed on distilled water indicated amino acid leakage takes place after irradiation. No such effect could be demonstrated in the non-irradiated controls. Comparative chromomatographic studies with the media on which irradiated and non-irradiated ciliates have been growing indicate that serine and perhaps methionine are utilized rapidly in the irradiated organism. At present nucleic acid and cell permeability studies are in progress.

CLARKE, C. A., and P. M. SHEPPARD. Disease in Relation to Human Polymorphic Systems. *Departments of Medicine and Zoology, University of Liverpool, Liverpool, England.*

Little is known of the factors which stabilise human polymorphisms, but three medical aspects of the problem have been studied. (1) *The ABO blood groups and gastro-intestinal disorders.* The association between peptic ulcer and blood group O was originally described by Aird and his colleagues in 1954. Family studies carried out by us where the unaffected sibs act as controls give no support to the hypothesis that group O predisposes to ulcer, whereas when general population controls are used the association has been found in many parts of the world. This apparent discrepancy will be discussed.

Non-secretion of the ABO blood groups and duodenal ulcer also appear to be associated, and possible explanations of this will be reviewed. Some light on the matter is obtained by estimating the fucose content of saliva, which gives a quantitative index of the amount of blood group substance present. Data on this matter will be considered.

Using fluorescine-labelled antibody technique, some information has also been obtained about ABO antigen sites on duodenal cells.

(2) *The ABO blood groups and Rhesus incompatibility.* It has been known since 1943 that incompatibility of ABO mating seems to confer a definite protection against haemolytic disease due to Rh incompatibility. "Rhesus" families have been studied to determine the ABO blood group and secretor character of children born before Rh antibodies have been produced in the mother, to test the hypothesis that the immunising foetus is usually ABO compatible.

(3) *The relationship between adenomatous goitre and the ability to taste PTC.* Earlier work has been confirmed which showed that there is a 40% incidence of non-tasters in patients with adenomatous goitre compared with 30% in a control series. These findings will be related to animal experiments in which water and PTC solution respectively have been offered to "taster" and "non-taster" rats.

CLARKE, C. A., and P. M. SHEPPARD. A Genetic Investigation of Mimicry. *University of Liverpool, Liverpool, England.*

Since 1862 much speculation on the mode of evolution of Batesian mimicry has occurred, but little experimental evidence has been accumulated. Two main hypotheses have been put forward. That subscribed to by R. C. Punnett and R. Goldschmidt maintains that, in butterfly mimicry associated with polymorphism, each new mimetic pattern must arise perfectly formed as the result of a single mutation, since the differences between all forms within a population are controlled by single genes. In contrast R. A. Fisher and E. B. Ford maintain that a mutant giving some mimetic resemblance arises and the pattern is gradually improved by the selection of modifiers of the new mutant's effect.

We have shown that in the African mimetic butterfly *Papilio dardanus* the sympatric South African forms are controlled by a multiple allelomorphic series and that *hippocoonides* is recessive to *natalica* which is recessive to *cenea* which is recessive to both *leighi* and *trophonius. Leighi* and *trophonius* have an intermediate heterozygote called *salaami*; and *natalica* and *trophonius* also have an unnamed intermediate heterozygote.

If the gene controlling *cenea* is introduced into the gene-complex of *P. dardanus dardanus* from Ghana, where *cenea* itself does not occur, an imperfect mimetic resemblance results, demonstrating the presence of modifiers improving the mimicry in South Africa. However, when South African *cenea* is introduced into the gene-complex of *P. d. dardanus* from Uganda, where *cenea* is found at low frequency, there is only a slight decrease in the perfection of the mimicry. Two rather similar allopatric forms *hippocoonides* and *hippocoon*, which mimic different subspecies of one model, do not differ by a pair of allelomorphs as predicted by Goldschmidt but are multifactorially controlled as predicted by Ford. These results demonstrate the validity of Fisher and Ford's view on the evolution of mimicry. Racial crosses using the primitive non-mimetic subspecies from Madagascar are being made and these should throw further light on the evolution of mimicry.

CLAYBERG, CARL D. Genetically Determined Precocious Centromere Division in *Lycopersicon esculentum* Mill. *Connecticut Agricultural Experiment Station, New Haven, Conn., U.S.A.*

A meiotic abnormality found in an unfruitful mutant in the tomato variety Earlypak is controlled by a single recessive gene *pc*. The mutant is characterized by the regular occurrence of precocious centromere division of chromosomes in meiosis, resembling a case reported by Lamm (1944). The division begins in anaphase and is complete in practically all of the chromosomes by prophase of the second division. Following the separation of homologs, some chromosomes lag and frequently divide into daughter chromosomes during late anaphase. Most of the chromosome centromere division seems to occur during interkinesis. At metaphase of the second division all undivided and divided chromosomes *regularly* become oriented on the plates. Both types segregate to the poles, the latter without again dividing. As a consequence of considerable lagging in the second division, restitution nuclei are frequently formed. The resulting diploid gametes may give rise to polyploid offspring although the mutant normally possesses extremely low pollen and ovule fertility.

CLAYTON, GEORGE A. The Effect of Size of Breeding Population on Residual Genetic Variance. *Institute of Animal Genetics, University of Edinburgh, Edinburgh, Scotland.*

This experiment is part of a general investigation into the nature and magnitude of genetic variation retained in breeding populations. The aim was to measure the actual residual genetic variance after a high theoretical level of inbreeding had been reached in populations inbred at different rates.

The character measured, the sum of the bristles on the 4th and 5th sternites of *Drosophila melanogaster*, has a total variance of 11.2 and an additive genetic variance of 5.8 in the large panmictic cage population which provided all the experimental lines. At least 80% of the total genetic variance is additive and the realized heritability is 50% ± 2%. The character appears to be affected by large numbers of genes of small effect and there appears to be little if any correlation between bristle number and fitness, at least within the phenotypic range encountered in the base population. This character thus appears to meet all the requirements of the theoretical drift model.

Four rates of inbreeding were studied: 20, 10, 5 and 1 pair of parents per generation. There were 4–5 replicates within each group. All lines were subjected to two-way selection for three generations when they had reached a computed level of inbreeding of 87%. The results showed that at the slower rate of inbreeding, viz., the 20's and the 10's, considerably more additive genetic variance was retained than theory would allow. The 5's and full-sibs declined according to prediction. There was a noticeable degree of heterogeneity between replicates.

The principal conclusions are that computed Coefficients of Inbreeding will almost invariably overestimate the rate of loss of genetic variance and that the effective number of parents must be extremely small for the drift process to play a significant role.

CLISE, RONALD L. Factors Contributing to the Low Survival Rate of Bar Eyed *Drosophila melanogaster. Fenn College, Cleveland, Ohio, U.S.A.*

Two populations of *Drosophila melanogaster* were grown in a series of culture bottles connected with each other through large diameter glass "T" tubes. This method, an adaptation of the population bottles of Reed and Reed, allowed relatively large population to be maintained in minimum incubator space without undue fluctuation in population size.

Flies taken from the population were used to determine mating capacities and the frequencies of the various mating combination, bar × bar, wild × wild, bar × wild, etc. In addition, the fertility of females was determined with regard to both the number of eggs laid and the number of imagos resulting.

The mating capacities of wild and bar eye males, based on 192 matings, were in the ratio of 1:.52. Fertility of females was in the ratio of 1:.94:.36 for heterozygous bar, wild, and homozygous bar females respectively, based on the number of eggs. These ratios were, in the same order, 1:.93:.46 when based on the number of imagos produced by 159 females. The fertility ratios were established after it had first been determined that the type of male involved in each mating did not significantly affect the fertility of the female.

The above ratios were expressed as selection factors and predictions of gene frequencies were made. After adjustment to account for the overlapping of generations inherent in sampling of populations, the predicted gene frequencies were not significantly different from the observed frequencies. Reduced mating capacity on the part of the male, and reduced fertility in the female thus appear to be the major factors contributing to the failure of the bar eye gene in competition with the wild type.

Cocito, Carlo, and Henry J. Vogel. Heritable Lowering of an Enzyme Level and Enzyme Repressibility Observed upon Continuous Cultivation of *Escherichia coli* in the Presence of a Repressor. *Institute of Microbiology, Rutgers, The State University, New Brunswick, New Jersey, U.S.A.*

Escherichia coli (ATCC No. 9637) was grown at about 30°C, without forced aeration, in a continuous cultivation device, essentially the turbidostat of Bryson (Science, *116*: 48), on a glucose-salts (minimal) medium with or without a supplement of L-ornithine hydrochloride (20 mg. per liter). The resulting cultures were sampled at daily intervals and streaked to single colonies on unsupplemented solid medium. From such colonies, stock cultures in liquid minimal medium containing casein hydrolysate (0.2%) were derived. For assays of the enzyme acetylornithinase, inocula from each stock culture (after preliminary growth on liquid minimal medium) were cultivated on (*a*) minimal medium, and (*b*) minimal medium supplemented with L-arginine hydrochloride (0.1 micromole per ml.). Enzyme levels (in enzyme units per mg. protein) and enzyme repression were determined, as previously described (Vogel, The Chemical Basis of Heredity, Johns Hopkins, 1957, p. 276), in extracts of sonically disrupted organisms. Both ornithine and arginine are repressors that antagonize acetylornithinase synthesis.

Between the third and seventh day of continuous cultivation in the presence of ornithine, isolates were obtained that exhibited acetylornithinase levels(determined without arginine) ranging downward to 10–15% of those of the inoculum used. Some such isolates showed greatly lowered or no repressibility with respect to the synthesis of this enzyme. In contrast, isolates from continuous cultures grown without ornithine showed no substantial decreases in acetylornithinase levels, but often showed increases; the repressibility of these isolates tended to remain high.

The isolation of clones exhibiting reduced levels of acetylornithinase and reduced degrees of repressibility of acetylornithinase formation aids in interpreting the further finding that strains of several genera of Enterobacteriaceae showed considerable variation, regardless of taxonomic position, in acetylornithinase level and repressibility. (Aided by the Damon Runyon Memorial Fund and the National Science Foundation.)

Cockerham, C. C. *See* Legates, J. E., *et al.*; Robinson, H. F., *et al.*

Cockerham, C. Clark. *See* Kojima, Ken-ichi.

Coe, E. H., Jr. A Continuing, Non-Reverting Conversion-Type Phenomenon at the *B* Locus in Maize. *U.S. Department of Agriculture* and *University of Missouri, Columbia, Mo., U.S.A.*

The established alleles at the *B* locus are *B*, B^w, and *b*, in order of dominance and decreasing depth of color. Dominance is very nearly complete, and standard segregation ratios are obtained. In a progeny of self-pollinated *B B* (strong-colored) plants, two weak-colored individuals similar to B^w appeared. Self-pollinations of these exceptions and crosses to *B B* egg parents failed to give strong types in the progeny. Even after three cycles of selfing and of repeated backcrossing to *B B* as male and female no strong plants have been obtained. The exceptional weak type is designated B'. Crosses of $B' \times b\ b$ give weak ($B'\ b$) and on selfing show 3 weak: 1 colorless. Crosses of $B'\ b \times B\ B$ give half weak ($B'\ B$) and half strong ($B\ b$). These results demonstrate the absence of a transmissible cytoplasmic factor and mark the effect as genetic and at the B-locus. The effect is not due to exclusive transmission of the B' chromosome since normal segregation with b and linked markers is obtained. The effect differs from the phenomenon at the R locus, reported by Brink, in being entirely regular in the change which occurs, in continuing to "pass on" the effect, and in failing to revert to the standard type when made homozygous. Since the immediate generation from crosses is weak, whatever change occurs is assumed to come about at fertilization. B' plants continue to appear occasionally in the original $B\ B$ line.

COHEN, CARL. A Second Interaction Antigen in the Rabbit. *Battelle Memorial Institute, Columbus, Ohio, U.S.A.*

The cellular antigen which results from the interaction of two allelic genes is relatively rare. Irwin has found a hybrid substance in a species cross in doves and Miller has shown that in at least one of these crosses the hybrid antigen is the result of interaction of two allelic genes, each of which is capable of giving rise to a detectable antigen. The interaction antigen I occurs in the heterozygote Hg^A/Hg^D of the three allele series Hg^A, Hg^F, and Hg^D. In a continued study of this locus a second interaction antigen has been found to occur in the heterozygote Hg^A/Hg^F. This antigen, labelled J, is most unusual in that it also occurs as the direct product of the gene Hg^D.

The antibody which detects this second interaction antigen was prepared by the immunization of recipient of type A by the blood of a donor of type D. By suitable absorption an antibody was isolated which agglutinates the cells of animals of genotype Hg^A/Hg^F and also animals of the genotype Hg^D. A second antibody prepared by absorption of the original whole serum agglutinates cells of type D only. A third antibody, called anti-K, was also prepared from the original serum and is capable of agglutinating the cells of all animals carrying the gene Hg^F or Hg^D.

Breeding experiments using matings of type A by type F yield offspring of type A F J. In no case does either parent react with anti-J; in every case the offspring reacted with anti-J.

The antigen J resulting from the interaction of the genes Hg^A/Hg^F appears to be serologically identical to the antigen J which is controlled by the gene Hg^D. Antigen K occurs as the result of the presence of either the gene Hg^D or the gene Hg^F.

COLE, KATHLEEN. A Cytogenetic Investigation of Some Marine Algae of the Pacific Coast. *Department of Biology and Botany, University of British Columbia, Vancouver, B.C., Canada.*

A cytogenetic study, based chiefly on marine algae grown in culture, is being carried out in an attempt to solve some of the problems concerning the speciation of certain members of the Pacific Northwest flora. Such a study establishes the presence or absence of morphological alternation of generations on a cytological basis. Species of several genera in each of the Chlorophyta, Phaeophyta, and

Rhodophyta have been observed, and developmental stages of some of these have been successfully obtained in culture. Belling's iron-aceto-carmine squash technique was used with good results on all forms so far investigated. Depending on the particular alga under study, certain modifications such as prefixation in different solutions, mordanting with iron alum, and prolonged heating were found necessary. This method is particularly suitable for a cytogenetic survey because it is simple, rapid, stains the nuclei effectively, and may be used even in the field. Flagella, cell walls, cytoplasmic inclusions, pyrenoids, nuclear membranes, nucleoli, and chromosomes were readily observed following treatment with iron-aceto-carmine. Unusual mitotic divisions similar to those reported in certain fungi were noted in several forms. The study is continuing in an attempt to obtain chromosome counts and a more detailed knowledge of both the cytological and morphological aspects of the life cycles of the marine algae of this region.

COLOMBO, GIUSEPPE. X-ray Induced Impairment of Fecundity and Fertility of *Bombyx mori* females. *Istituto di Zoologia dell'Università di Padova, Padova, Italy.*

Each female of the silkworm *Bombyx mori* L. lays all her eggs at one time; the steps of egg maturation are rather strictly related to the developmental stages. Therefore it is possible to irradiate at various stages females whose ovaries contain germ cells almost at the same stage. Females, as well as males, have been irradiated by X-rays (Therapeutic Philips Apparatus, 50 kv, 2mA, F 0.5 A1, d. f. 60 mm; 950 r/min.) at third and fifth larval stage and early and late pupae with 1,000 r, 2,000 r, 4,000 r and some with 8,000 r, by varying the length of exposure.

The irradiated females were crossed with untreated males of the same egg-brood, the males with untreated females of another egg-brood of the same race. The number of laid eggs (fecundity) and that of hatched larvae (fertility) were recorded.

Above 2,000 r fecundity decrease is higher among the females treated at the fifth larval stage and early pupae than among the irradiated late pupae. These effects show that the sensitivity of the oocytes is higher during the 2nd period of growth than during vitellogenesis. Fertility, which can be considered a test for induced dominant lethals, is more affected in later stages of oogenesis than in earlier ones, which means that metaphase chromosomes are more sensitive than prophasic ones. These results are in agreement with those obtained in *Drosophila.*

The impairment of fecundity appears to be mainly a cytoplasmic effect of irradiation which would affect the differentiation and growth of oocytes rather than the structure of chromosomes.

A stage of oocyte growth particularly sensitive to X-rays is the second period of growth when nurse cells produce large amounts of RNA which is used for the synthesis of structurally homogeneous cytoplasm in the oocytes. X-ray treatment probably interferes with RNA production and/or RNA utilization.

CONGER, A. D. The Fate of Metaphase Exchanges. *Biology Division, Oak Ridge National Laboratory, Oak Ridge, Tenn., U.S.A.*

Radiation-induced chromosomal damage is measured by observation of all aberrations at metaphase in favorable materials, and by observation of bridges and fragments at anaphase in less favorable materials. The assumption is made that a constant proportion of the important exchange aberrations (dicentrics and rings) seen at metaphase give rise to bridges at anaphase. Sheldon Wolff has recently shown this is not true, at least in barley, where he found metaphase exchanges increased as dose^{2}, anaphase bridges as dose^{1}. Metaphase exchanges could fail to produce detectable bridges at anaphase either by (*a*) dividing in a "fall-free" manner, thus making no bridge, or (*b*) making a bridge, which then breaks.

It was possible to analyse in *Tradescantia* exchanges at metaphase, bridges and fragments at later anaphase, and also exchanges and their manner of separation (as fall-frees, criss-cross or interlocked bridges) in very early anaphase. With increasing dose, metaphase and early anaphase exchanges increased as dose$^{1.6}$, and were seen in almost equal numbers. Bridges at later anaphase increased as dose^{1}. Over the dose range studied, a constant proportion, about half, of all exchanges separated in a fall-free manner. The discrepancy between metaphase exchanges–detected anaphase bridges is therefore not caused by a changing fraction of exchanges that fall free, but must be caused by bridges that break, the fraction breaking increasing with dose. An association between restituted radiation-induced breaks, and breakage of anaphase bridges, could explain the results. Radiation-induced breaks increase proportionately to dose; if restituted breaks are weak points in a bridge, then breakage of anaphase bridges would likewise increase proportionately to dose.

CORCORAN, PATRICIA A. *See* ALLEN, FRED H., Jr., *et al.*

CORDEIRO, A. R., J. IVES TOWNSEND, J. A. PETERSEN, and EUTERPE C. JAEGER. Genetics of Southern Marginal Populations of *Drosphila willistoni. University of Rio Grande do Sul, Brazil,* and *University of Tennessee, Knoxville, Tenn., U.S.A.*

Drosophila willistoni, a neotropical species which prefers the warm humid rain forests of northern and central Brazil, has nevertheless a wide distribution ranging from southern Florida to Montes Tordillos, 200 km. south of Buenos Aires. For the purpose of investigating the genic polymorphism of marginal populations, strains in a sample from the "Hacienda El Destino," near the city of La Plata, were rendered homozygous for a *second* or a *third* chromosome. Of a total of 320 different homozygous second chromosomes, 6.25% were semilethal and 27.18 ± 2.3% were lethal, giving a combined value of 33.43 ± 2.6% lethals + semilethals. This value is significantly lower than 41.2 ± 1.1% for tropical Brazil determined by Pavan *et al.* (1951) in a total of 2,004 strains and does not differ from the 32.24 ± 1.6% Cordeiro *et al.* (1958) found in 794 strains from Rio Grande do Sul, Brazil, or from the 31.1 ± 4.4% found by Townsend (1952) in 109 strains from Florida. Of the 97 different homozygous third chromosomes, 20.61 ± 4.2% were lethal, and the combined value of 28.8 ± 4.6% lethals + semilethals does not differ significantly from the 31.1 ± 1.4% Pavan *et al.* (1951) found in 1,166 strains from tropical Brazil or the 32.8 ± 4.2% Townsend (1952) found in 122 strains from Florida. This work confirms the findings of Townsend for northern marginal populations of *D. willistoni* and supports the explanations given in Carson's (1955) review of the problems of genetic composition of marginal populations of several species, according to which a lower degree of genetic polymorphism is correlated with harder environmental conditions, less specialization, and a smaller number of ecological niches occupied by the organism. (Work supported by grants from the Rockefeller Foundation, the Conselho Nacional de Pesquisas (Brazil), and CAPES (Brazil).)

CORDEIRO, A. R., F. M. SALZANO, V. B. MARQUES, and J. A. PETERSEN. Experimental Shift from Genetic Balance of Natural Populations of *Drosophila willistoni. Division of Genetics, University of Rio Grande do Sul, Porto Alegre, Brazil.*

Southern natural populations of *Drosophila willistoni* inhabit isolated small woods scattered in the grassland region of Tainhas in the north of Rio Grande do Sul. Samples of these populations were crossed with northern Brazilian races and the F_1 hybrids (N/S) proved to be heterozygous for six "new" inversions not present in the Tainhas region: XL-Bb, Dd, Ff, Gg, Hh; XR-Ee; and carried more than 50 per cent of IILAa IIR Ee and III Jj (chromosome map, Dobzhansky, 1950; Da Cunha *et al.*, 1950). More than 60,000 hybrids N/S individuals raised in the laboratory were released at each of the three isolated woods no. I, IV and V, at the beginning of the summer of 1956, when their population sizes are at least 30 times smaller than the hybrids received. Cytologic analysis of control and experimental woods was performed in eleven samples made during the summers of 1956 and 1957, totaling 698 karyotypes of single F_1 larvae produced by isolated cultures of one female each. Statistical analysis reveals heterogeneity between some inversions in control (1956, 1957), but it is more evident between control and experimental woods. It is of interest that three out of six "new" inversions were incorporated in wood I, but not one in IV and V. The incorporated are: XL Dd at 17.07 per cent (1956), 2.56 per cent and 2.17 per cent (1957); the XL Bb zero per cent (1956), 2.56 per cent (1957); and the XR Dd 19.51 per cent (1956), 2.17 per cent (1957). The control wood showed zero per cent of these inversions consistently. *Heterotic inversions*: the IIR Ee (90.63 per cent in N/S) increased about 10 per cent (24.07 per cent, wood I; 31.62 per cent, wood IV) in 1956 dropping down to control values in 1957 (10.91 per cent, wood I; 11.76 per cent wood IV). The most heterotic inversion III Jj (Pavan *et al.*, 1957) in several places in Brazil did not increase during 1956 but became heterotic in wood I (52.83 per cent in 1957). The hybrid stock has twice as much inversion per individual as compared with control Tainhas and its release raised 1 to 2 per cent mean percentage of inversions in 1956, but in 1957 a reduction in control values occurred.

Most of the genetic novelties introduced in the populations of *Drosophila willistoni* at Tainhas were lost, and the "new" incorporated inversions remained at low frequencies. The genetic homeostasis of Mendelian populations depends on the maintenance of certain levels of heterozygosity (Lerner, 1954) which is attained by a slow process of genotype intergration (Dobzhansky and Wallace, 1953) and coadaptation of genotype systems of balanced polymorphism, all of these processes conditioned by natural selection. The genetic structure of Mendelian population *in naturae* has strong homeostatic properties that tends to reject abrupt or drastic changes even if these are for a further increase in heterozygosity. The levels of heterozygosity show a close connection between adaptive responses and the environment. (This work has been supported in part by grants of the Conselho Nacional de Pesquisas, the Rockefeller Foundation, and the University of Rio Grande do Sul.)

CORLETTE, S. *See* RUDKIN, G. T.

COWDEN, RONALD R. RNA Distribution in Chromosomes during Mitosis and Meiosis. *The Johns Hopkins University, Baltimore, Maryland, U.S.A.*

Cytochemical investigations were undertaken on distribution of RNA in various meiotic and mitotic cells during the division cycle. In all cases prior digestion in pH 6.0 DNAase, 0.01% at 37°C for one hour was used before staining in 0.025% azure B bromide at pH 4.2 for two hours at 37°C. The material used included grasshopper testes, mouse testes and slug ovotestes; for mitoses grasshopper hemolymph cells, onion root tips, and human kidney tissue culture cells were employed. In all cases there was a progressive increase in the binding of metachromatic azure B bromide as the chromosomes condensed. The nucleoli showed a general decrease in size and an irregularity in outline as the cell progressed towards metaphase. The metaphase chromosomes appeared to bind dye maximally with no discernible reduction at anaphase. The telophase chromosomes showed some reduction in basophilia. By the time cleavage was complete, most of the chromosomal basophilia had disappeared, and the nucleoli reappeared.

Although this has been suggested by several past cytological studies, no direct evidence has been recorded in the literature as to direct observation of chromosomal RNA during mitosis and meiosis other than that of Swift *et al.* (1956), who published absorption data and figures of RNA distribution during grasshopper spermatogenesis.

CRAIG, ELLEN MEESON. Point Mutation, Its Rate and Biochemical Effects Considered in Relation to Senescence. (*Private*), *47 Prospect Hill Rd., Camberwell, Australia.*

Theoretically, true point mutation is produced by chemical alteration in the structure of a single gene. It therefore should not require mitosis for its production. The number of point mutations should always be a function of time and the rate of point mutation largely independent of the number of mitoses. This becomes important when considering somatic mutation and its effects on normally non-mitotic essential parenchyma of the well-developed adult organism. As all types of mutation when dominant or homozygous are more often deleterious than otherwise, and as, in terms of biochemical genetics, each confers on its possessor a specific biosynthetic inability, it follows that point and occasionally other somatic mutations summate through the years in each parenchymal cell of a tissue to cause a slow deterioration in its independent synthetic ability. This may be compensated for at first by substances present in sap or circulation, either as diffusible products made in surplus by still unmutated or differently mutated other cells, or as essential substances absorbed. Finally, as somatic mutation continues, all such compensatory mechanisms must break down, and senile deterioration becomes the inevitable outcome, accompanied by a lowering of resistance to disease and an end of the vigorous period of life. Nevertheless, all mutations cannot produce specific biosynthetic inabilities in their possessors. True advance in biochemical complexity could not have been made in evolution unless certain mutations confer added biosynthetic abilities, producing added independence of substances supplied in the environment (Horowitz

Proc. Nat. Acad. Sci. U.S. *31*:153). Increased study of reverse mutation should evolve better reactivating methods whereby somatic cells might be induced to maintain their biosynthetic abilities and vigor in spite of increasing years, thus prolonging the useful part of life.

CRARY, D. D. *See* SAWIN, P. B.

CROSBY, JACK L. The Elucidation of a Problem in *Primula* Evolution by Means of the Electronic Computer. *Botany Department, Durham Colleges in the University of Durham, Durham, England.*

Electronic computers are particularly well adapted to mathematical treatment of evolutionary processes. Micro-evolution is essentially iterative; initial gene frequencies of one generation are altered by a system of forces and the new frequencies are the initial values of the next; the process then repeats itself. Tedious calculations of such processes are greatly simplified by electronic computation, in which iterative calculations are extremely economical of the operator's time; changes in the system of forces can be simulated by automatic modifications of the generating equations, and complicated situations are easily handled.

But nature never follows calculations neatly. Statistical fluctuations may lead to acceleration or complete stoppage, and their consequences when the rate of evolution is changing rapidly are difficult or impossible to estimate. An electronic computer can superimpose random variability on evolutionary calculations; it can therefore run through the same evolutionary process many times but with different results. Such repetition involves no extra work for the operator, and it produces a representation of many isolated populations evolving in the same way, but independently, from similar beginnings.

The evolution of homostyly in *Primula vulgaris*, an account of which appeared in *Evolution* in 1949, will be taken as an example. Certain modifications of the generating equations there given will now be introduced since later work has provided more accurate information about the fertility of the four genotypes involved. The result will be compared with the known population pattern in nature.

The calculating machine has introduced artificiality into evolution studies because the time factor enforces over-simplification. The high speed of the electronic computer allows the consideration of far more factors, and a more realistic and useful approach can be made to natural conditions. This will be valuable to us so long as we prefer the elucidation of evolutionary processes to their use as bases of mathematical fantasy.

CROWE, LESLIE K. The Exchange of Genes between Nuclei of a Dikaryon. *Harvard Biological Laboratories, Cambridge, Mass., U.S.A.*

In intraspecific matings between homokaryotic and dikaryotic mycelia of tetrapolar fungi in the Basidiomycetes, there have been instances in which the homokaryon has been dikaryotized by a nucleus which differed genetically from both nuclei of the dikaryon. An understanding of this phenomenon has previously been hindered by the lack of adequate marker genes.

Using strains of *Schizophyllum commune* in which markers linked with both the A and B mating type factors are present, dimon matings have been analysed.

Matings in which both nuclei of the dikaryon are compatible with the homokaryon have shown the following reactions: (1) migration of one nucleus of the dikaryon to form a new dikaryon with the resident nucleus in the homokaryotic mycelium (31 cases); (2) migration of the intact dikaryon through the homokaryotic mycelium to supplant the resident monokaryon (6 cases); (3) formation of a new nucleus by exchange of segments, or possibly of entire chromosomes, between the nuclei of the dikaryon (this new nucleus, in which the genotypic characters of the components of the dikaryon are recombined, migrates to form a dikaryon with the resident nucleus of the homokaryotic mycelium) (5 cases); (4) formation of sterile dikaryons in which the genotype of the component haploid nuclei has yet to be determined (5 cases).

It is concluded that new genotypes can arise during the vegetative growth of a dikaryotic mycelium. Since the experiment was designed in a way which gave no apparent selective advantage to recombinant nuclei, they must arise frequently. Recombination may occur either by the fusion of the component nuclei of the dikaryon to form a regular diploid nucleus, or by the overlapping of the spindles during conjugate division resulting in irregular segregation. The latter cause would give rise to many unbalanced nuclei which may account for the sterility of some of the dikaryotic isolates.

CUANY, ROBIN L., ARNOLD H. SPARROW, and ALEXANDRA H. JAHN. Spontaneous and Radiation-Induced Somatic Mutation Rates in *Antirrhinum*, *Petunia*, *Tradescantia*, and *Lilium*. *Biology Department, Brookhaven National Laboratory, Upton, N.Y., U.S.A.*

Plants heterozygous for one or more flower color genes have been treated acutely with X-rays or chronically with gamma radiation from cobalt 60. Small spots or streaks of phenotypically different color appear at random positions on flowers treated as young buds, and occur spontaneously at a low rate. Such changes are referred to as somatic mutations, in a broad sense. The great majority of the mutant areas are quite small but sectors as large as a branch are occasionally produced. These can be propagated asexually into plants bearing only the new mutant flower type. Unfortunately, genetic testing of this material is difficult, since our results so far indicate that the mutant tissue is originally mericlinal, becoming periclinal after propagation, and confined to the epidermis. Such mutations may be of direct value in vegetatively propagated crops, and ways of increasing their frequency and modifying their chimeral nature are being sought.

Antirrhinum, Petunia, Tradescantia, and *Lilium* all show a linear response of mutation rate to gamma dose rate. Average mutation rates expressed per million cells of mature petal, per unit increase in dose rate, are much greater in *Tradescantia* than in *Antirrhinum* or *Petunia*. *Lilium* shows a still higher somatic mutation rate of the order of 300 spots per roentgen increment of daily dose. This is over two hundred times the rate for *Antirrhinum* or *Petunia* under chronic irradiation. With acute X-ray treatment of *Antirrhinum* flower buds, the average somatic mutation rate per r per cell is 2×10^{-6} above the spontaneous rate of 50×10^{-6}.

While many factors can influence mutation rates for various loci in different plants, the data suggest a possible relationship between radiation-induced somatic mutation rate and chromosome size in the genera tested. Such a relationship would indicate that these so-called somatic mutations are more likely to represent chromosome aberration than point mutation.

(Research carried out at Brookhaven National Laboratory under the auspices of the U.S. Atomic Energy Commission.)

CUNHA, A. B. DA, J. S. DE TOLEDO, C. PAVAN, H. L. DE SOUZA, M. L. PIRES DE CAMARGO, and L. C. DE MELLO. A Comparative Analysis of the Effects of Natural and of Radiation-Induced Lethals in Heterozygous Individuals and of Their Frequencies in Natural Populations of *Drosophilia willistoni. Universidade de Sào Paulo, Faculdade de Filosofia, Ciencias e Letras, Departamento de Biologia Geral, Sào Paulo, Brazil.*

The hypothesis that the lethal genes present in natural populations, and subjected to natural selection for generations, are less deleterious in the heterozygous condition than newly induced lethals, has so often been repeated that it is now almost accepted as a fact. However, the hypothesis is based almost on theoretical arguments only. We had, in the preparation for our experiments in the islands of Angra dos Reis, an opportunity to test the validity of this hypothesis.

Several lethal genes were induced by X-rays in the second chromosome of *D.willistoni* and 10 of them were taken at random for experiments. At the same time 11 second chromosome lethals were isolated from flies caught in the islands. Flies with the induced and the naturally occurring lethals were raised in the laboratory and released in the islands. No allelism was found with the genes concerned. This test was also used to study the effects of lethals in heterozygous individuals. Individuals heterozygous for two induced lethals and individuals heterozygous for the laboratory marked chromosome 207 (chromosome with a dominant marker gene, a recessive lethal and an induced inversion to prevent crossing-over) and one induced lethal are obtained when the allelism between the induced lethals is tested. In the allelism test between the natural lethals, heterozygotes for two natural lethals and heterozygotes for 207 and one natural lethal are produced. Finally, in the allelism test between natural and induced lethals, heterozygotes for one natural and an irradiated lethal are obtained together with heterozygotes for one 207 chromosome and one natural or one irradiation-induced lethal. These types of crosses permit the comparison of the viabilities for the three types of heterozygotes, heterozygotes for two natural lethals, for two induced lethals, and for two lethals one natural and one induced, taking the hybrid class 207 as a basis. Crosses were made in all possible combinations with the two classes of lethals. Each cross was repeated 5 times with a total of 100 flies analysed for each. The number of the wild-type individuals $\frac{\text{lethal 1}}{\text{lethal 2}}$ for the 500 flies of each cross was taken as the measure of the viability of the heterozygote for the two lethals. From the data obtained it can be concluded that in *D. willistoni,* at least under laboratory conditions, there are no differences in the effect of natural and of X-ray induced lethals on the viabilities of heterozygotes.

The frequencies of the natural and of the induced lethals, used in the experiments above, in natural populations were also studied.

The frequency of the lethal genes in the natural populations studied was found to be of the order of .0005–.0006. The value q for *D. willistoni* populations, taking 2.2×10^{-5} as the mutation rate for this species, is 0.0015.

The experimental value found 0.0005 is much lower than the expected indicating that the lethals are selected against in the heterozygous condition. The hypothesis of genetic drift to explain the low frequency of the lethals is improbable but not totally excluded.

CURTISS, ROY. *See* LEVINE, MYRON.

DALY, KEVIN. An Analysis of Quantitative Variability in *Nicotiana*. *Department of Plant Breeding, Cornell University, Ithaca, N.Y., U.S.A.*

An investigation of the response of quantitative variability to selection has been initiated with a transgressive line derived from interspecific hybridization. This line originated from the F_1 hybrid of *N. langsdorffii* with *N. sanderae* var. "Sutton's Scarlet" and was advanced by single-plant selection and selfing. The mean of this line exceeded the upper limit of the larger-flowered parent for the selected feature, corolla tube length. To gain information on the nature of gene action controlling the transgressive phenotype, measurement data were collected in a single environment from selfing and backcrossing series with each parent. An analysis of means and variance components has been completed for the selected character and three unselected characters. An indication of the existence and relative magnitude of additive gene action, dominance, and epistasis could be anticipated from this analysis. Expectations for means and variances were developed from a model suggested by Robson (1956) as an alternative to the Hayman-Mather (1955) model for genic interaction under selfing. Three epistatic parameters for digenic interactions, additive × additive, additive × dominance, and dominance × dominance, were estimated in addition to additive and dominance effects. Tests of gene effects showed all estimates to be significantly different from zero. The additive genetic effect exceeded the dominance effect for each of the four characters. The relative magnitude of dominance was found to be less for the selected character than for the unselected ones. Variance component estimates were consistent with results for gene effects in indicating the presence of non-allelic gene interactions. The major portion of the increase in size of the selected line over its larger parent could be attributed to additive gene action and the remaining smaller portion to additive × additive interaction.

DANSEREAU, PIERRE. Character Variations and Shift of the Ecological Frame in the Species of *Cistus*. *University of Montreal, Montreal, Canada.*

The prevalence of hybridization in the homoploid genus *Cistus*, and the relative uniformity of the Mediterranean climate throughout the range of the 17 species make them highly responsive to the play of natural selection. Local populations of most of the species have been measured by the mass-collection technique: some, such as *C. bourgeanus* (a southern Iberian endemic) and *C. populifolius*, are fairly homogeneous; others such as *C. ladaniferus,* are highly variable. The causes of variability may be traced in the first place to the location of many populations very near a present or former bioclimatic boundary (the live oak–semideciduous oak line, for instance). On the other hand, immediate site conditions favour a segregation of types that is strongly accentuated by man's impact on the landscape. Introgression, by and large, has worked towards a more xerophytic cast in the populations of *C. ladaniferus, C. villosus, C. crispus, C. monspeliensis,* and *C. symphytifolius.*

These populations and the related taxa that are also endemics of the Canary Islands show the very same behaviour as the truly Mediterranean species, but this is unfolded within a very different vegetation matrix.

Experimental plants grown in Gran Canaria, at the Botanical Garden in Coimbra, at the University of Michigan Botanical Garden and at the Montreal Botanical Garden, permit an evaluation of the relative role of hereditary characters in these otherwise very plastic plants.

DAREVSKAYA, E. M. *See* BAKHTEYEV, F. KH.

DARK, S. O. S. Some Interactions of *Xanthamonas malvacearum* with the B Series of Black-Arm Resistance Genes in Cotton. *Empire Cotton Growing Corp.* and *Sudan Government, Ministry of Agriculture,, Khartoum North, Sudan.*

In the irrigated Gezira district of the Sudan, the cotton crop is protected from black-arm disease, caused by *Xanthamonas malvacearum,* by very expensive cultural practices, and more recently by the use of 3 genes for black-arm resistance, B_2 (from Upland cotton), B_3 (from *G. punctatum*) and B_6 (from *G. arboreum bengalense*), transferred into the long-staple *G. barbadense* which is grown commercially as two black-arm susceptible varieties called Sakel (S) and Lambert (L).

Degree of resistance of individual plants is graded on a scale 0(immune)-12(fully susceptible), determined by the type and size of leaf spots produced after spraying with a suspension of the bacterium in water under standard conditions.

For many years the reactions of these genes and their combinations were reported to be constant when they had been transferred by repeated back-crossing to the Sudan commercial cottons.

R. L. Knight found that on a *G. barbadense* background, B_2 gave grades 5–7, B_3 gave 4–7, B_2B_3 gave 3 and B_2B_6 gave 4–5. The combination B_2B_3 was considered to give field resistance to the Sudan crop, although water-logging of the plants could break it down temporarily.

In 1956 the resistance of S and L cottons carrying B_2B_3 broke down temporarily owing to water-logging in the Gezira, but in Shambat their mean resistance grades were 5.5 and 5.0 respectively. In 1957 the Gezira had no black-arm outbreak, but in Shambat the mean grade fell to 8.2 and the resistance was indistinguishable from that of B_2 alone.

Evidence from past records and the present season's experiments is conflicting. On the average it seems to indicate that a more virulent strain of bacterium has evolved at Shambat despite lack of selection pressure, for inoculum has always been maintained on a fully susceptible variety of cotton.

DASSAT, PIETRO. Effect of Inbreeding on Milk Production in Sheep. *Istituto di Zootecnica generale, Università Sassari, Torino, Italy.*

The objective of this investigation was to study the effect of inbreeding on milk production in sheep. The analysis wàs made using the records of a flock of Sardinian sheep (*Ovile Sardo*) set up near Cagliari (Italy) in which a programme of deliberate inbreeding was started before the Second World War to try to produce "superior inbred stock" and to reduce variability. The data available were the first lactation yield in 170 days (standard length) for 564 outbred and 87 inbred animals, and the average fat percentage in first lactation for 381 outbreds and 59 inbreds.

To investigate the effect of inbreeding on yield and fat percentage all the calculations were done within recording years and the differences between outbreds and inbreds, $F = 0.125$, and between outbreds and inbreds, $F = 0.25$, weighted according to the numbers in the groups. The over-all average decline in yield due to inbreeding was 16.54 kg for $F = 0.125$ and 21.03 kg for $F = 0.25$, with a total weight of 7.04 ± 3.7 (approaching significance at the 5% level) and 10.84 ± 5.3 (significant at the 5% level) respectively.

There was some effect on fat percentage and to be exact the decline has a total weight of 0.08 (not significant) for $F = 0.125$ and of 0.32 ± 0.14 (significant at the 5% level) for $F = 0.25$.

The results are in agreement with the existing information about the effect of inbreeding in dairy cattle. About the magnitude of the effect, if we consider an average production of 120 kg milk and 6.5% fat, there is a 9% decline in yield for an F value of 0.25 (i.e., 0.36% change in yield for each percentage increase in the inbreeding coefficient) and a 5% decline in fat percentage.

DAVIES, A. J. S. *See* WYLIE, ANN P.

DAWSON, CHARLES D. R. The Origin of Tingeless May King Lettuce. *A. L. Tozer Ltd., Cobham, Surrey, England.*

May King Lettuce is grown in North European countries in cold frames, glasshouses and as an early outdoor crop. It is early maturing and has good quality, but possesses a defect in that on exposure to cold it develops a reddish-brown tinge on the head. This is disliked on the British market.

A crossing and backcrossing programme has been carried out at Cobham whereby the dominant gene responsible for the reddish-brown tinge has been replaced by its recessive allele introduced from the variety Tozer's Cobham Green. Two new varieties have been produced, Tozer's Mayfair and Tozer's Maybelle, which have all the good qualities of May King, but do not develop any reddish-brown tinge on exposure to low temperatures.

DEGENHARDT, KARL-HEINZ. Analysis of Intra-Uterine Malformations of the Vertebral Column Induced by Oxygen Deficiency in Rabbits. *Institut für Humangenetik der Universitat Münster/Westf., Münster/Westf., Germany.*

In our experimental studies with pregnant doe-rabbits oxygen deficiency proved to be a teratogenic agent adequate for determination of "phase specificity"

("Phasenspezifität") of axial developmental aberrations. Our test series (exposure of pregnant animals to a single test of oxygen deficiency of a few hours duration) indicated the following: the development of axial organ anlagen can be influenced at certain stages, e.g., between the eighth and tenth day of pregnancy (axial gradients were most responsive to alteration on the ninth day of gestation). We found a definite correlation between intensity of the agent (oxygen deficiency), response of the axial (metabolic) gradients and amount of the malformation rate, on the one hand, and between date of the test (during pregnancy) and localization of malformations induced by oxygen deficiency ("cranio-caudales Entwicklungsgefälle"), on the other.

On the basis of these findings, we were able to throw more light on the pathology of the spine, i.e., of its anlage during intra-uterine development. Kladetzky and this author (1955) found that on the ninth day of pregnancy, oxygen deficiency does not primarily affect the vertebral primordium but rather the notochord. Consequently, it is the abnormal cell metabolism of the notochord that induces pathological development of the vertebrae. These results were corroborated by those obtained on Danforth's short-tail mouse, as reported by Theiler (Zurich). There is a similar relationship between pathological function of the notochord and abnormal development of the periaxial mesenchyme (prenatal formation of the disks). Both pathological gene and exogenous agent seem to influence such developmental processes of embryonic organs.

Our observations with rabbits include series of frontal and sagittal sections of embryos submitted to oxygen deficiency (between the ninth and thirty-first day of pregnancy) as well as sectional material of controls.

DELAMATER, EDWARD D. Observations on the Nature of Isolated Bacterial Nuclei. *Section on Cytology & Genetics, Department of Physiology, University of Pennsylvania, Philadelphia, Pa., U.S.A.*

Methods for the isolation of bacterial nuclei have been developed. The methods consist of exposing the cells to bile salts which soften the wall, permitting easier rupture. The released nuclei are subsequently freed from the fragmented cell walls by lysozyme or differential centrifugation. Cytochemical and chemical analyses of the isolated structures indicate the chromosomal nature of the isolated material. Cytochemical evidence indicates the presence of structures comparable to those described in the intact cell, including chromosomes, spindle element, and centriolar-like bodies. Electron microscopy of the isolated material confirms and extends the cytochemical evidence of the nature of the isolated chromosomes and other nuclear structures. The presentation will include photographic evidence substantiating this evidence.

DEMARINIS, F. Asymmetry in the Double Bar–Eyeless *Drosophila melanogaster*. *Department of Biology, Fenn College, Cleveland, Ohio, U.S.A.*

Bilateral asymmetry of eye-sizes is studied in the double bar–eyeless females ($BB/+$, ey^2/ey^2) in *Drosophila melanogaster*. The eyeless factor is used to emphasize asymmetry and *BB*-factor is used to reduce the facet-number. A facet count was made on 2,650 flies. The distribution of the eye-size *vs.* number in each group approximated $y = ab^{-x}$, where y = the number of eyes, x = eye size, and a and b are constants. A further analysis of the classes within each group showed still different type distributions. Each class was determined on the basis of a specific eye size on one side of the head. The tentative results and conclusions derived from these data are: (1) each class gives a different and distinctive type of eye-size distribution; (2) these distributions change with definite regularity from class to class; (3) the same law of distribution operates on either side; (4) developmental events (in relation to facet number) occurring on one side regulate the events occurring on the opposite side; and (5) it has been deduced that the *ey*^{2}-gene acts very early in development. Its action has been estimated as occurring sometime during the early migration of the cleavage nuclei from their central position in the egg to their presumptive eye regions of the oöplasm.

DEMPSTER, EVERETT R., I. MICHAEL LERNER, and NOBRIO INOUYE. Fertility, Viability, and Sex Ratio of the Immediate Progeny from X-irradiated Sperm in Chickens. *Department of Genetics, University of California, Berkeley, Calif., U.S.A.*

In connection with a project for the study of induced genetic variation of continuously variable traits in chickens, experiments were performed to test fertility of eggs from pullets inseminated with sperm irradiated at different dosages, and the viability and sex ratio of the embryos produced. The precise percentages of eggs fertilized were difficult to determine on account of abortive development of unfertilized eggs; different results were obtained when eggs were examined without incubation as compared to results from examination of non-viable eggs after one week's incubation, and the results according to either method of examination were not altogether consistent between experiments. By contrast consistent and regular results were obtained regarding the number of embryos alive at fourteen days divided by the total number of eggs set, when expressed as a proportion of the same quotient used for controls. The relationship between dosage, from zero to 2,000 roentgens, and proportion of surviving embryos closely approximates a simple exponential function. The proportion surviving at 2,000 r units, relative to controls, is 15%. The over-all sex ratio does not deviate significantly from 50%, nor is the variation between experiments significant, as indicated by chi-square tests. The total number of eggs set in these dosage experiments is over 7,000 and the total number of live embryos that were sexed is nearly 4,000.

DEMPSTER, EVERETT R. *See* LERNER, I. MICHAEL, *et al.*

DE SERRES, F. J., and G. KØLMARK. Quantitative Estimates of Radiation-Induced Forward-Mutation Rates at the *ad-3A* and *ad-3B* Loci in *Neurospora*. *Biology Division, Oak Ridge National Laboratory, Oak Ridge, Tenn., U.S.A.*

A method has been developed that permits the direct determination of the total number of *ad-3* mutants in a given population of cells after mutagenic treatment. The success of the method depends on the fact that *ad-3* mutants accumulate a purple pigment in the mycelium, which readily distinguished such mutants from wild type. All conidia surviving mutagenic treatment are grown on minimal medium supplemented with adenine and the purple mutants are recovered on the basis of the characteristic color of the mature colonies. An experiment was performed to study the effect of various X-ray treatments; a comparison was made of the forward-mutation rates obtained with aliquots of a suspension of microconidia (strain K76-OR2-7A) untreated, and irradiated with 4.5, 18, 36 or 72 kr. No purple mutants were recovered in the untreated control in 7.6×10^6 viable conidia, whereas 191 purple mutants were recovered from the four different X-ray treatments. The frequencies of purple mutants per 10^6 survivors at each dose were as follows: 4.5 kr, 2.41 ($16/6.64 \times 10^6$); 18 kr, 5.08 ($26/5.2 \times 10^6$); 36 kr, 33.3 ($76/2.28 \times 10^6$); and 72 kr, 182.5 ($73/0.4 \times 10^6$). The genotypes of individual purple mutants were determined in subsequent heterokaryon experiments using *ad-3A* and *ad-3B* tester strains. Of the 191 purple mutants, 35 were *ad-3A* and 156 *ad-3B* mutants. No double *ad-3A ad-3B* mutants were recovered and no evidence was obtained for the presence of other loci that mutate to phenotypically identical purple mutants either in the *ad-3* region or elsewhere in the chromosome complement. A comparison of the total number of mutants of each type gives an *ad-3A*:*ad-3B* ratio of 1:4.5, indicating a greater sensitivity of the *ad-3B* locus to X-radiation than the *ad-3A* locus. With this strain, maximum forward mutation rates of 9.7 and 2.1 per 10^6 viable conidia treated for the *ad-3B* and *ad-3A* loci, respectively, are expected with a dose of about 55 kr.

DIAMOND, L. K. *See* GERALD, P. S.

DIAMOND, LOUIS K. *See* ALLEN, FRED H., Jr., *et al.*

DICKIE, MARGARET M. Genic Control of the Gonad-Adrenal-Pituitary Triangle: An Hypothesis. *Roscoe B. Jackson Memorial Laboratory, Bar Harbor, Maine, U.S.A.*

Study of postcastrational changes in several inbred strains of mice has shown that, following an injury to the endocrine homeostasis, strains compensate to varying degrees with development of pathological changes in the adrenal glands. Pathological changes are accompanied by biochemical changes, i.e., abnormal adrenals produce sex steroid hormones that stimulate the accessory reproductive organs. Type of compensation is constant for each strain, indicating genic control of the compensatory potential.

To elucidate the genic control of the postcastrational changes, F_1 reciprocal hybrids of some of these inbred strains were examined. Certain strains may compensate identically (phenotypically), but F_1 hybrids of any one of these strains crossed with a different strain reveal some potentials of the parental strains that may have been suppressed in the parental environment but are operative in a new environment. The hybrid potential is not always intermediate between the parental types but may be cumulative so that there appears to be over-compensation (heterosis).

Reciprocal backcrosses of certain hybrids to the parental strains are now being examined. These backcrosses reflect the segregation and recombination of parental and hybrid compensatory potentialities.

It is suggested that the potentialities of the control system, the GAP triangle (gonad-adrenal-pituitary), are of genetic origin and that these compensatory abilities are dependent upon the interactions of at least five polygenic loci. Two of these polygenic complexes are primary, one controlling the general susceptibility or potential of the organism to compensate and the other controlling the normal regulation and interaction of the GAP triangle. In addition there are three specific complexes acting directly and specifically on the adrenal-gonads, the pituitary, and the accessory reproductive organs; and determine, within the limits of the first two complexes present, the quantity and quality of compensation there shall be in the control system, the GAP triangle.

DICKINSON, A. G. Maternal Effects in Cattle. *Animal Breeding Research Organisation, Edinburgh, Scotland.*

In a crossbreeding experiment involving all types of matings among Friesian, Ayrshire and Jersey cattle, the effect of maternal size has been investigated by comparing reciprocal crosses in various ways, using information on weight and body size from birth to 2 years of age. Altogether 13 characters were analysed and a close relationship was found at birth between the relative maturity of the characters and the relative sizes of their maternal effects. Two types of maternal effect are involved depending on whether the crossbred is from the larger or smaller maternal breed, but in both cases the effect diminishes progressively with age of the calf. The main conclusions indicate how an understanding of maternal effects might facilitate a selection programme by permitting selection to be carried out at an early age.

DI PASQUALE, ANNA, and SUSY KOREF SANTIBANEZ. "Pseudotumors" in Natural Populations of *Drosophila melanogaster* and *Drosophila simulans. Istituto di Genetica, Università di Milano, Milan, Italy,* and *University of Chile, Catedra de Biologia, Santiago, Chile.*

The behavior and incidence of "pseudotumors" in descendants of female *Drosophila melanogaster* and *Drosophila simulans* caught in nature were studied for several generations under laboratory conditions. The genetic factors for this trait are being examined in several of the lines of *Drosophila melanogaster.* An analysis for genetic variability is made among these lines.

DISSOSWAY, CAROLYN F.-R. *See* ROBERTS MARGARET R., *et al.*

DLUHY, ROBERT G. *See* FANKHAUSER, G.

DOBZHANSKY, TH. *See* BEARDMORE, J. A., *et al.*

DONOVAN, LORNE STEWART. The Inheritance of Leaf Size in Broadleaf Birdsfoot Trefoil, *Lotus corniculatus* L. *Forage Crops Division, Central Experimental Farm, Canada Department of Agriculture, Ottawa, Canada.*

The inheritance of leaf size was studied in crosses involving the large-leafed "*variety vulgaris*" and the small-leafed "*variety arvensis.*" Results indicate that the genetics of this character is relatively simple in that it appears to be mainly under the control of one gene. This gene shows incomplete dominance and there is evidence that the allelic interaction is geometric in nature rather than arithmetic. Backcross ratios of 1:4:1 and 1:2:1 were obtained which are indicative of autotetraploid segregation where the chromosomes pair at random. However, a factorial hypothesis established wholly on this simple basis does not satisfactorily explain the results. Gene interactions, which at present are unknown, are thought to be involved.

Cytological examination of the parent plants showed chromosome pairing to be chiefly as bivalents. Quadrivalent formation was rare. If this species is of autoploid origin as the backcross ratios indicate, the process of reversion to the diploid type of chromosome behaviour is fairly complete and therefore disomic, tetrasomic and di-tetrasomic ratios can be expected.

DOUDNEY, C. O. *See* HAAS, FELIX L.

DOWRICK, G. J. *See* WILLIAMS, WATKIN.

DOYLE, ROBERT J. The Effects of Age of Culture on the Production of Kill and Cytachrom Deficient Yeast by Ultra-Violet Light. *Detroit Institute of Cancer Research, Wayne State University, Detroit, Mich., U.S.A.*

Haploid cultures of an adenine-deficient mutant of *Saccharomyces cerevesiae* were irradiated with ultra-violet light. Improved methods enabled us to show that, through linear portions of survival curves, the production of cytochrome-deficient or "petite" cells varied with age of culture and, in mature cultures, followed a probability relation with dose. The meaning of these curves will be discussed.

DRISCOLL, SHIRLEY G. *See* HSIA, DAVID YI-YUNG.

DURRANT, A. Environmentally Induced Inherited Changes in Flax. *Department of Agricultural Botany, University College of Wales, Aberystwyth, Wales.*

A number of experiments carried out over the past five years have demonstrated that large differences in the weight of flax plants can be produced by the effect of the environment on previous generations of plants. Several environmentally conditioned types, which have remained practically unchanged for at least four generations, have been obtained by growing plants of a single, inbred, self-fertilising variety in various combinations of nutritional and seasonal factors. Although some types are as much as two and three times the weight of others, the plants within the types are highly uniform; for this and other reasons the differences cannot be explained in terms of residual genetic variability within the variety.

The differences are probably due to cytoplasmic change rather than to maternal effects since plant weight is not positively correlated with seed weight. Moreover, conditioned types which were reciprocally grafted remained unchanged in both stock and scion, and crosses of two conditioned types showed some transference of effect through the pollen in both directions. It is likely that the changes are brought about by the effect of mineral supply and temperature/light relations on the relative rates of division of cells and cytoplasmic particles, and the persistence could be due to the altered cytoplasm interacting with the nucleus to establish a new nucleus-cytoplasm equilibrium. The conditioned types do not respond in the same manner to different environments.

DUVICK, DONALD N. The Regional Localization of Pollen Sterility in Partially Sterile Cytoplasmically Pollen Sterile Maize. *Pioneer Hi-Bred Corn Company, Johnston, Iowa, U.S.A.*

Various degrees of partial pollen sterility occur when certain maize genotypes are transferred into cytoplasms which induce pollen sterility. When individual tassels are examined, one anther at a time over the entire expanse of the tassel, it is seen that in general the anther to anther correlation for percentage of sterile pollen grains tends to increase with increasing proximity of the anthers on the tassel. For example, anthers within the same floret are more likely to have similar percentages of sterile pollen than are anthers in different florets. There is a tendency for "islands" of sterility or conversely for islands of fertility to occur on the tassel. These islands may range in size from two to three anthers to several florets, several spikelets or portions or all of a tassel branch or primary axis. This tendency for regional similarity in degree of pollen sterility will be discussed with reference to the theory that partial pollen sterility is caused by random segregation of particulate entities and also with reference to the effects of external and internal environmental factors on the expression of cytoplasmic pollen sterility.

EBERSOLD, W. T., and R. P. LEVINE. Chiasma and Chromatid Interference in *Chlamydomonas reinhardi. Biological Laboratories, Harvard University, Cambridge, Mass., U.S.A.*

Four markers, *arginine-1*, *arginine-2*, *p-aminobenzoic acid-2*, and *thiamin-3*, are located in linkage group 1 of *Chlamydomonas reinhardi*. From two crosses involving these markers 1,530 unordered tetrads were analysed with respect to the following considerations: (1) gene order and map distance—the sequence of markers is *arg-1—arg-2—pab-2—thi-3* and the intervals *arg-1—arg-2* (region I), *arg-2—pab-2* (region II), *pab-2—thi-3* (region III) are 5, 15, and 31 map units in length, respectively; (2) position of centromere—the centromere is not within the interval studied, but is approximately 15 units to the left of *arg-1*; (3) chiasma interference—coincidence values for regions I-II, II-III, I-III are 0.19, 0.31, and 0.70, respectively and thus chiasma interference decreases as the length of the interval under consideration increases; (4) chromatid interference. Among 701 tetrads from cross 1, the ratios of 2-:3-:4-strand double exchanges are: regions II-III, 10:20:6; regions I-III, 8:16:6. These do not deviate significantly from 1:2:1 ($P>0.5$). However, using a method for estimating chromatid intereference developed by Whitehouse certain triple exchanges are used as a basis for "correcting" the frequencies of 2-, 3-, and 4-strand relationships. Negative chromatid interference is indicated since the ratios above are converted to 19.62:14.33:2.05 (regions II-III; $P<0.001$) and to 15.84:13.65:0.51 (regions I-III; $P<0.001$). Regions I-II were not considered since only two double exchanges involving these regions were found. The data obtained from the analysis of 829 tetrads from cross 2 provide no evidence for chromatid interference. The method of estimating chromatid interference used above was not applicable to these data since no triple exchanges were found.

(Supported by research grants from the National Science Foundation (G-2812) and the National Institute of Health (E-1421).)

EGELHAAF, ALBRECHT. *See* KÜHN, ALFRED.

EGGERS, G. W. N. *See* BLUMEL, JOHANNA, *et al.*

EHLING, U., E. KROKOWSKI, and H. G. MEHL. The Uptake of Radioactive Elements in Bones by Skeleton Mutants of Rabbits. *Max-Planck-Institut für vergleichende Erbbiologie und Erbpathologie, Berlin-Dahlem, Strahleninstitut der Freien Universität Berlin, Berlin-Dahlem, Germany.*

The uptake of ^{45}Ca, ^{32}P and ^{89}Sr in the skeleton was examined in Dachs, Pelger and hypoplasia-pelvis rabbits. The genes under investigation were found to cause different kinds of morphological changes. In Dachs rabbits the Dachs gene (*Da*) is responsible for a general reduction of the body size in the homozygote and to a lesser degree in the heterozygote and for significant localized effects upon the endochondral bones of the skull and the limb girdles. In Pelger rabbits the Pelger gene (*Pg*) prevents a normal segmentation of the leucocytes. The nuclei remain in an early segmented stage. In homozygous condition the Pelger gene has a lethal effect. In the super-Pelger (*Pg/Pg*) the nuclear segmentation of the leucocytes is completely suppressed, so that the nuclei are round. The extremities of the super-Pelger rabbits are deformed, ribs and long bones are shortened. In hypoplasia-pelvis rabbits the recessive gene (*hyp*) is responsible for a hypoplasia of the femur and a reduction of the ischium. The reduced ischium impairs development of the acetabulum.

Intensity of the skeletal metabolism depends upon the age of the animals. In comparison with normal rabbits there is an accelerated uptake of phosphorus by the bones of Dachs and super-Pelger rabbits, whereas in hypoplasia-pelvis animals the uptake is delayed. This proved to be true when ^{32}P had been directly injected, as well as in the progeny of female rabbits to which ^{32}P had been applied intravenously. The distribution of ^{45}Ca, ^{32}P and ^{89}Sr within the various bones has been checked by means of autoradiographs.

Eigsti, O. J. Chromosomes and Speciation as Represented in *Polygonatum. Chicago Teachers College, Chicago, Ill., U.S.A.*

The pollen tubes of a triploid show considerable variation in the number of chromosomes from one pollen tube to another when comparing the types among a population obtained from a single flower. This variation is a notable contrast to the constancy exhibited with related species that are diploid and tetraploid, respectively. There are differences between triploids according to the origin of the triploid. This demonstration includes data from cultures obtained over a period of several years. Selected specimens of pollen tubes from diploids, triploids and tetraploids of the genus *Polygonatum* will be available for observation with the microscope. An evolutionary significance of the chromosomal variations as well as the constancy of numbers is noted in these studies.

Ellis, Jack R. Intergeneric Hybridisation between *Fragaria* and *Potentilla. University of Manchester, Manchester, England.*

In a recent series of intergeneric pollinations between the cultivated octoploid strawberry and six British species of *Potentilla*, some fairly vigorous intergeneric hybrids have been raised from crosses where the *Fragaria* cultigen was used as the female parent. The Potentilla species used were *P. fruticosa* ($2n = 14$), *P. erecta* ($2n = 28$), *P. reptans* ($2n = 28$), *P. sterilis* ($2n = 28$), *P. palustris* ($2n = 42$) and *P. anglica* ($2n = 56$), these forming a polyploid series from diploid through tetraploid and hexaploid to octoploid. Four of these *Potentilla* species *P. fruticosa*, *P. erecta*, *P. palustris* and *P. anglica* were highly successful as pollinators, giving large fruits, each with a large number of well-developed achenes. *P. reptans* and *P. sterilis* were completely unsuccessful as male parents, there being no observable stimulation following any pollinations. Germinations occurred in all the hybrid seed though the percentage of seed which germinated and the longevity of the hybrid seedlings varied considerably between the different hybrid cultures.

The most successful of the *Potentilla* species used was × *P. palustris* because the hybrid seed had the highest germination and the lowest degree of seedling lethality. Many vigorous mature heptaploid hybrid plants ($2n = 49$) were raised from this cross. The cross × *P. fruticosa* also gave mature hybrid plants having the expected pentaploid number of chromosomes ($2n = 35$). The variety of this species used (grandiflora) was less successful than *P. palustris*, for the hybrid seed had much lower germination and a higher incidence of seedling lethality. In × *P. erecta*, × *P. anglica* all the hybrid seedlings originating from these two species of *Pontentilla* died within a few weeks of germination.

All the intergeneric hybrids with *P. fruticosa* were completely sterile, and thus gene exchange between octoploid strawberries and *P. fruticosa* does not seem feasible on account of the prevailing sterility which persisted even in the colchicine doubled hybrid ($2n = 70$). As no fertility details are available for the hybrids with *P. palustris* at the time of writing, no decision can be made on the possibility of using this species in strawberry breeding.

Emerson, Mary R. *See* Emerson, Sterling.

EMERSON, STERLING, and MARY R. EMERSON. Protoplasts of *Neurospora crassa.* *Division of Biology, California Institute of Technology, Pasadena, Calif., U.S.A.*

When cultured in media containing appropriate enzymes, for example those present in commercial hemicellulase preparations, the "osmotic" mutant strain of *Neurospora crassa* produces "protoplasts." These protoplasts have something resembling a thin cell wall, but they burst when the osmotic concentration of the medium is sufficiently lowered, leaving a ruptured ghost membrane.

Protoplasts arise as extrusions through pores in the walls of hyphal cells, or directly upon germination of conidia. They are, or soon become, coenocytic, possessing as many as a hundred or more nuclei. In media containing enzymes, protoplasts increase in size and reproduce by rather equal or unequal division, sometimes by a process superficially resembling budding. In the absence of enzymes, and in suitable media, protoplasts sooner or later produce a hyphal-type growth which is resistant to osmotic shock.

Protoplasts of *Neurospora* appear to be especially well suited to certain types of genetic and biochemical studies.

EMSWELLER, S. L., and JOSEPH UHRING. Apogamic Seedlings of Tetraploid *Lilium longiflorum* Thunb. *Plant Industry Station, U.S. Department of Agriculture, Beltsville, Maryland, U.S.A.*

The diploid chromosome number of *Lilium longiflorum* Thunb. is 24. Attempts to obtain triploids by using colchicine-induced tetraploids as maternal parents in crosses with diploids have been made during the past 10 years. In 1954 one capsule that contained 12 seed was obtained. Of these 9 germinated and produced weak seedlings that grew very slowly as compared with diploid or tetraploid seedlings. An occasional diploid seedling flowers in 10 months and a tetraploid in 18 months. Some of the 9 seedlings flowered in 3 years and the remainder during the fourth year.

A cytological examination of these 9 seedlings showed that 8 had 24 chromosomes and the ninth 25. The chromosomes of 6 of the plants were morphologically typical for the species. Plant 7 had a modified B and a modified C chromosome resulting from loss of a piece of the C chromosome including its secondary constriction and attachment of the fragment to the short arm of a B chromosome. Plant 8 also had a modified B and a modified C chromosome, practically identical with those in plant 7, except for attachment of a little larger piece of the C chromosome to the short arm of the B chromosome. Plant 9 had an extra chromosome identified as a modified C indistinguishable from the modified C of plant 7.

The findings indicate that plants 7, 8, and 9 originated from the unfertilized egg cells of the tetraploid. Cytological examination of the tetraploid showed a high frequency of chromosome pairing including bivalents, trivalents, quadrivalents and a few difficult-to-analyse associations of more than 4 chromosomes. Finding of 3 modified C and 2 modified B chromosomes indicates a probable homology between B and C chromosomes. The remaining 6 plants with normal-appearing chromosomes may be of either matroclinal or patroclinal origin. They are actually induced haploids of the tetraploids.

ENDRIZZI, JOHN E. Cytogenetic Study of Frego Bract and a Translocation in Cotton. *Texas Agricultural Experiment Station, College Station, Texas, U.S.A.*

American cultivated cotton, *Gossypium hirsutum*, is an amphidiploid with A and D subgenomes. Heterozygous reciprocal translocations in the amphidiploid commonly show adjacent type of disjunction at metaphase I, and progenies are recovered that are duplicate and deficient for the interchanged segments. Because of the deficiency, these are useful for locating genes on specific chromosomes.

One duplication-deficiency type (Z692) was used as female and crossed to a multiple recessive marker line which included the recessive gene for abnormal bracts called frego. Approximately half of the F_1's had the frego phenotype. Thirteen non-frego or normal F_1's were analysed cytologically and all had normal bivalent pairing at metaphase I as expected, hence, heterozygous for frego. Sixteen frego F_1's were analysed and they had the Z692 arrangement as expected, hence, hemizygous for the frego gene.

Selfs of the normal F_1's segregated as expected in the ratio of 3 normal to 1 frego. Selfs of the hemizygous frego class segregated in the ratio of approximately 3 frego to 1 normal. The latter or normal class was assumed to be due to the transmission of duplicate-deficient gametes through the male and fusing with like gametes in the female. Such individuals would be homozygous deficient for the length of the interchanged segment carrying the frego locus and autotetraploid for the length of the other interchanged segment. This was supported by the fact that a new type of arrangement of four chromosomes was found at metaphase I in this class. Backcross of this group to frego should verify the assumption.

Cytological analysis of hybrids of Z692 arrangement with a D genome species and an interchange involving only A genome chromosomes showed that the interchange is between chromosomes in the A and D subgenomes and that the frego locus is in an A chromosome.

The double duplicate and deficient type is fully fertile and shows that interchanges may be useful for adding and/or subtracting segments in the chromosome complement of cotton with the intent of improving its economic characters.

The fact that plants homozygous deficient for the frego locus have normal bracts is some indication of the nature of the "duplicate homologue" in the amphidiploid.

ENGEL, KARL-HERMANN. Effect of Inbreeding and Crossbreeding in *Solanum tuberosum. Deutsche Akademie der Landwirtschaftswissenschaften zu Berlin, Institut für Pflanzenzüchtung, Rostock, Germany.*

Comparing the investigations of parents and their in- and cross-breedings for some typical characters, such as yield, starch content, flesh colour and tuber shape, we try to explain the results by Mendelian segregations on the hypothesis of both dominance and superdominance. We are still working on this problem.

ESSER, K. The Significance of Semi-Incompatibility in the Evolution of Geographic Races in *Podospora anserina. Botanisches Institut der Universität Köln, Köln-Lindenthal, Germany.*

In Fungi and flowering plants, where the phenomenon of incompatibility is determined by various genetic and physiological mechanisms, genetically identical gametes are invariably incompatible. Heterogenetic individuals, except for rare cases, are compatible. Up to the present time the belief was justified that incompatibility serves as a mechanism for the prevention of inbreeding.

In contrast the incompatibility in inter-race crosses of *Podospora anserina* differs in its genetic basis, its realization and its evolutionary effect. This incompatibility is based on the occurrence of semi-incompatibility (SI) between genetically heterogeneous sex organs. Thus inbreeding and isolation of races are promoted.

This isolation cames about in two separate ways, both of which depend on the same action of the semi-incompatibility genes. (1) In crosses involving SI the number of hybrid perithecia is reduced to half because only one of the two reciprocal crosses yields fruiting bodies. The cumulative action of the two SI mechanisms can completely block sexual reproduction when both reciprocal crosses are blocked. (2) If hybrid fruiting bodies arise in SI crosses, genetic equilibrium among the progeny is significantly altered in favour of certain genes. The result is that in the homocaryon specific mutations arise, whereas in the heterocaryon particular nuclei are eliminated. For the latter, the existence of binucleate spores which contain two of the four meiotic products is a prerequisite.

EVANS, ALICE M. Grafting and Hybridization in the Genus *Trifolium*. *Welsh Plant Breeding Station, Aberystwyth, Wales.*

Previous workers have shown that *Trifolium* is a genus displaying very little interspecific compatibility. Hence a new approach was essential and new techniques had to be evolved in any worthwhile attempt to overcome the barriers to crossing within the genus. Michurinist geneticists in the U.S.S.R. have claimed that "vegetative rapprochement" can be used for making distant crosses compatible. In consequence such grafting methods were applied in the genus *Trifolium*.

Reciprocal grafts were made between selected species at different levels of ploidy, and it was found that some scions developed normally, others were stunted, while others died very soon after grafting. Where the grafts succeeeded, hybridization between stock and scion was attempted and the success of these hybridizations was compared with that obtained by crossing ungrafted plants. It became evident that grafting prior to crossing did not increase crossability of species, but where stock × scion and scion × stock crosses were successful, it was also possible for the control plants to be successfully hybridized.

The data also showed that the grafting technique served as a sieve in that those genotypes that did not graft likewise did not hybridize. Thus on retaining for hybridization only those genotypes which were compatible as grafts, there was a selection for the most compatible genotypes. Graft compatibility hence became an indication of the relationship between species. The significance of these results will be discussed.

EVANS, E. BURKE. *See* BLUMEL, JOHANNA, *et al.*

EVANS, LAURIE E. *See* JENKINS, B. CHARLES.

FAHMY, O. G., and MYRTLE J. FAHMY. Differential Cell-Stage Response to Mutagens. *Chester Beatty Research Institute, Royal Cancer Hospital, Pollards Wood Research Station, Chalfont St. Giles, England.*

The effect of the cell stage during spermatogenesis in *Drosophila melanogaster* on the mutation yield (as regards sex-linked recessive lethals) under the effect of different mutagens has been investigated by the "brood" technique. Males were irradiated or injected with a single dose of a chemical mutagen, and their progeny was fractionated by repeated matings to a succession of virgin females; the mutation rate in each fraction (or brood) was determined separately. The fluctuations in the brood-mutation curve were analysed with a view to the elucidation of how far they were a function of the cell stage response during spermatogenesis, and whether this response was a function of the mutagen.

Variation in the brood-mutation curve sometimes occurred with the same mutagen owing to factors inherent in the technique itself, mainly as a result of: (a) cell killing at high doses of some chemical agents, (b) variation in the speed of germ line differentiation, and (c) alteration in the experimental procedure particularly the brood period. In spite of these spurious variations, however, it was possible to detect some gross trends in the brood-mutation curves which seemed to be characteristic of the various agents. X-radiation, tri(ethyleneimino) triazine, diepoxybutane, as well as the acid nitrogen-mustards (with carboxylic side chains), were shown to produce their maximal mutagenic effect on the earlier spermatids. The basic nitrogen-mustards (i.e., amino-acid derivatives), on the other hand, produced high mutagenic effect on all stages of spermatogenesis, with slightly higher selectivity on the spermatocytic and late spermatogonial stages. The methanesulphonic esters were highly active on the sperm and late spermatids and their effect gradually decreased in the earlier germ cell-stages. Two compounds, 2-chloroethyl methanesulphonate and S-chloroethyl cysteine, acted selectively on the spermatogonial stages.

It was, therefore, concluded that mutagenic response depended on the physicochemical state of the genetic material during germ-cell differentiation, and that the spectrum of this response varied with the mutagen.

FAHMY, MYTLE J. *See* O. G. FAHMY.

FAILLA, G. Relation between Spontaneous Mutation Rate and Mortality Rate. *Radiological Research Laboratory, Columbia University, New York, N.Y., U.S.A.*

When the logarithm of the age specific death rate, r, is plotted against age, t, in years, the portion of the curve beyond middle age is approximately a straight line, represented by the equation $r = r_0e^{-\alpha t}$, where α is the slope. If it is assumed that aging is due to somatic mutations, it may be shown that α represents the average spontaneous mutation rate per cell per year for the cells concerned. A representative value of α for human populations is 0.085. If the diploid cell contains 4×10^4 genes and one generation is 30 years, the mutation rate derived from this value of α is 6.4×10^{-5} per gene per generation. The corresponding rates for mouse, rat, and *Drosophila* at 25°C, derived from published mortality data, are all about 7.8×10^{-5}. Obviously the close agreement is due in part to the choice of the number of genes per diploid cell (mouse and rat, 2×10^4; *Drosophila*, 10^4) and the generation time (mouse, 200; rat, 250; *Drosophila*, 12 days).

The product of α and the lifespan, which represents the average number of mutations that have occurred per cell at the end of the lifespan, is nearly constant for the four species (8 to 6) and does not involve any juggling of figures. Thus the spontaneous mutation rate per cell and per unit time is (roughly) inversely proportional to the lifespan. If the increase in mortality rate with advancing age is due primarily to the accumulation of somatic mutations, the lifespan is set by the inherent stability of the genetic system of the species, as represented by the spontaneous mutation rate in somatic cells.

FALCAO, D. N. *See* CAVALCANTI, A. G. LAGDEN, *et al.*

FALCONER, D. S. Genetic Correlation between Growth on High and Low Planes of Nutrition: An Experiment with Mice. *Institute of Animal Genetics, Edinburgh, Scotland.*

The theory of genetic correlation may be applied to the problem of interaction between genotype and environment, and leads in principle to a solution of the problem of how much of the improvement gained by selection carried out in one environment will be maintained if the improved strain is transferred to another environment. Any phenotypic measurement made in two different environments may be regarded as measuring two different "characters," and the degree of genetic similarity between the two characters, arising from pleiotropy, may be expressed as the genetic correlation. Knowledge of the genetic correlation and of the heritabilities of the two characters should then allow one to predict the improvement to be expected in character A if selection is made for character B. An experiment with mice was carried out with the object of testing this idea. The measurement made was of growth between three and six weeks, and the two environments in which growth was measured were high and low planes of nutrition. Two lines were selected for increased growth, one reared on high plane and one on low. Similarly two lines were selected for decreased growth. Selections were made from first litters, and second litters were reared in the other environment. Thus the response of both characters was measured in every generation. The genetic correlation was measured from a comparison of the direct response with the correlated response. Four such comparisons could be made: from the two characters, and from the two directions of selection. If the theory were adequate to deal with the problem, these four estimates would be consistent. The estimates from the two characters agreed well when based on the divergence between upward and downward selection. The genetic correlations were then 0.63 and 0.50. But the four estimates derived from consideration of the upward and downward responses separately did not agree at all. The discrepancy was due to asymmetry of the responses in the two directions, whose cause has not yet been traced, but is likely to be connected with maternal effects.

FALEK, ARTHUR. Hand Preference in Families. *New York State Psychiatric Institute, Department of Medical Genetics, New York, N.Y., U.S.A.*

A study of hand preference has been conducted in families of New York City school children (1) to determine the cause and total expressivity range of hand preference, (2) to explore the apparent interaction of genetic and conditioning factors, and (3) to establish, if possible, a family pattern of hand dominance which would explain the distribution of right- and left-handedness in children of the four mating combinations.

Of 5,118 families responding to a preliminary take-home questionnaire, a sample of all left to left matings and an equal number from each of the other three mating types were chosen. The given families were further examined by means of a home demonstration test, motor tests, and extensive interviews.

Statistically significant hand differences were observed in the children of the four parental matings by the demonstration test, and if the ambidextrous population was removed, by the motor tests as well. Only in the matings of right-handed fathers and left-handed mothers was the proportion of left-handed children significantly and consistently larger than the observed rates in the other three types of matings. Re-evaluation of the home demonstration test according to the Rife technique, while confirming his observations of an increase in the number of left-handed children in those families where one or both parents are left-handed, was nevertheless in agreement with the other findings of this study.

Evidence is presented that the hand preference of an individual is a result of both his genetic endowment and his early training in the home.

FANKHAUSER, G., and ROBERT G. DLUHY. Relative Constancy of Somatic Chromosome Numbers in Larvae of the Salamanders *Triturus viridescens, Pleurodeles waltlii,* and *Eurycea bislineata. Department of Biology, Princeton University, Princeton, N.J., U.S.A.*

Aceto-orcein squashes were made of the liver of larvae in different stages of development. A 15-minute pretreatment in 38% Niu-Twitty solution was found to facilitate the spreading of the chromosomes. A single liver may yield as many as 100 mitotic figures of which about one-third are countable.

In the liver of young *Triturus viridescens* larvae ($2n = 22$) at least 80% of the mitoses were found to be diploid, about 15% tetraploid. The remaining metaphases contained either 21 or 23 chromosomes, or were so thoroughly scattered by the squashing that no reliable count could be made.

In *Pleurodeles waltlii* ($2n = 24$) the liver of young larvae showed approximately the same percentages of diploid and tetraploid metaphases as in *Triturus.* Occasional mitoses with either 23 or 25, and a single figure with 26 chromosomes were found. No other deviations in chromosome number were encountered. Counts in a smaller number of *Eurycea bislineata* larvae ($2n = 28$) also revealed a great preponderance of diploid metaphases, and a small number of tetraploid figures.

The diploid chromosome complement of the *Pleurodeles* includes a pair of satellite chromosomes. Their relation to the nucleoli has not been investigated so far. However, studies of tailtip preparations stained *in toto* with Harris's hemalum have shown that each haploid chromosome set must contain two nucleolar organizers, since the maximum number of nucleoli present in epidermis nuclei of the tailfin is four for diploid, six for triploid, eight for tetraploid, and ten for pentaploid larvae. This is in contrast to the condition found in the axolotl, where the corresponding numbers of nucleoli at different levels of ploidy are two, three, four, and five (Fankhauser and Humphrey, 1943).

FARTHING, B. R. *See* LEGATES, J. E., *et al.*

Fechheimer, N. S. and L. O. Gilmore. Factors Affecting the Deoxyribose Nucleic Acid Content of Bovine Germinal Nuclei. *Department of Dairy Science, Ohio State University, Columbus, Ohio, U.S.A.*

Cytospectrophotometric measurements of Feulgen-stained DNA and chromosome counts were made on testicular samples taken from 18 bulls representing 5 dairy breeds of cattle. At the time of sampling the bulls ranged from 12 to 15 months of age. One testis of each bull had been injected with colchicine at 3 to 5 months of age; the other testis was used as a control. Feulgen-DNA determinations of 20 spermatogonia, 20 primary spermatocytes, and 20 spermatids were made from stained preparations of each testis. The DNA values obtained from each slide were corrected for variation in staining intensity by use of a section of *standard* liver on each slide.

Statistical analyses of these data show that there was no difference between colchicine-treated and untreated glands or between samples from bulls grouped by age. There were significant differences in mean DNA content, cell to cell variability of DNA content among breeds, and among individual bulls belonging to the same breed. A statistically significant discrepancy from the theoretical 1:2:4 ratio of the mean DNA content of the nuclei of spermatids, spermatogonia, and primary spermatocytes was found. These differences in nuclei of the germ line cells can be explained by an inconstancy of chromosomes within or among animals, or by the presence of two types of DNA in cattle nuclei with one of these types not associated with genetic determination.

Fejer, S. O. A Gene for Femaleness in Hermaphrodite *Lolium perenne* L. *Grasslands Division, Department of Scientific and Industrial Research, Palmerston North, New Zealand.*

An inbreeding programme in perennial ryegrass, coupled with selection, resulted in a high-tillering "pasture" and a low-tillering "hay" line. Selection in the first two generations was for herbage production, for quantitative inheritance studies. It had to be switched to high self-fertility in the following generations, but this left the main characters unchanged. The gene reported here emerged in two plants out of twenty-two in the third generation of the "pasture" line and had not been observed earlier. All flowers examined in these plants appeared to be purely female and the three anthers were replaced by three ovary-like structures. From open-pollination of these two plants a few seeds were set, not more than one per floret, and all the plants from these were normal and vigorous. Only two of these plants were self-fertile enough for further studies and twenty plants of each selfed progenies were grown to maturity. Both of these progenies contained plants with all flowers totally female, 5 and 6 out of 20, a nearly perfect 3:1 segregation ratio. All the 11 abnormal plants set again some seeds from open-pollination, but crosses of these plants to related normal plants from both lines were fully sterile, while normal plants in one progeny were nearly fully self-fertile. It is suggested that a factor, changing sex expression, is segregating here like a single recessive gene and the homozygous recessive "female" plants are sterile if pollinated by a plant carrying the gene in heterozygous condition. Another recessive gene segregating in one of the lines caused lethal albinism, but seemed to be independent.

Genes affecting sex expression in Gramineae were reported by Jones in dioecious maize, and Frankel and Fraser found a "base sterile" gene in hermaphrodite wheat which, according to Barnard, forms a series of changes towards "femaleness." However, a complete change due to one gene or gene complex is not known and the present case may support the hypothesis of Baker on simple sex control by auxins. It may also have complications for the developmental anatomy of floral parts and the operation of self-sterility systems.

FLORY, WALTER S., Jr. Speciation, Mitotic Chromosome Number, and Karyotype Evolution in the Amaryllidaceae. *Blandy Experimental Farm, University of Virginia, Boyce, Va., U.S.A.*

Cytological information is available for some species of almost half the known genera of the Amaryllidaceae. A predominating basic number 11 occurs in about half the genera known cytologically, and is the only known basic number of all or most species in 12 genera. Both static and dynamic genera occur. *Amaryllis* and *Crinum* represent static genera; in each the species are clearly differentiated and the cytological picture essentially constant.

This report deals chiefly with dynamic groups of which *Hymenocallis* and the genera of Zephyrantheae are illustrations. Taxa differentiation is here often difficult and chromosome disparities frequent. Evolution in these active genera results—singly or perhaps sometimes in combination—from hybridization, polyploidy, or chromosome changes with resulting aneuploidy. Genic changes presumably play some part. Ready production of viable seed as well as several types of asexual propagation tends to promote survival of newly evolved variants.

Artificially produced hybrids in Zephyrantheae (*Zephyranthes* × *Cooperia* species; *Z.* species hybrids and backcrosses; *Habranthus brachyandrous* × *H. robustus*, etc.), often between parents with differing chromosome numbers, illustrate experimentally a putatively rather frequent method of originating new natural types and taxa. Artificial, and putative natural, hybrids occur in *Hymenocallis* and other genera.

In the closely related genera *Zephyranthes, Cooperia* and *Habranthus* a euploid series of somatic chromosome numbers runs from 12, through 18, 24, and 48 to 54 and probably 72. Other natural taxa occur with numbers of 14, 25, 28, 38, 46 and 47 plus a fragment. Artificially produced derivatives have other numbers.

Somatic numbers from 38 through 40, 42, 44, 46, 48, 50, 52 and 54 to 69, 70 about 84 and 88 to 98 occur in various taxa of *Hymenocallis.* In hybrids or in *Ismene* section, additional taxa with numbers of 45, 56, 58 to 60, 74 to 80, and 104 to 110 are known. Taxa with 46 (or 69) or 40 chromosomes, all metacentric, are most prevalent. Telocentric chromosomes occur in complements of most taxa with other numbers. These other numbers usually reduce to 46 (or 69)—or 40—if half of the number of telocentrics is added to the number of metacentrics.

FOCKE, RICHARD. A New Way of Explaining the Frequency of Polyploid Plants in Certain Habitats. *Institut für Landwirtschaftl. Biologie, Abt. Genetik der Universität, Rostock/Mecklenburg, Germany.*

From the initial consideration that the "period of persistence" of mutated genes partly depends upon the degree of polyploidy and the mutation rate, some conclusions are drawn regarding the formation of favourable combinations of genes and the further evolution of forms caused by them. Observations and calculations are added to support the conjecture that there is a relation between the geographic distribution of the polyploids and the natural ionizing radiation occurring in those regions.

FORD, CHARLES E. *See* HAMERTON, JOHN S.

FORD, D. K. *See* YERGANIAN, G., *et al.*

FORD, LEE. Possible Pleiotrophic Effects of the "Gray" Gene in Collie Dogs. *Pacific Lutheran College, Parkland, Washington, U.S.A.*

Studies currently being done on the "gray" coat color gene, *dd*, in collie dogs, would indicate either that the gene in homozygous recessive condition has pleiotrophic effects, or that there is a very close linkage involved. To date in examination of 40 pedigrees involving 84 "grays," there have been found no examples of what could be termed "crossovers," hence at present pleiotropism is suspected. Effects of the *dd* condition include extreme dilution of pigment, resulting in "gray" coat color, decreased mentality to "moron" level, drastic effect on erythrocytes, leucocytes and platelets, possible vitamin-synthesis deficiency, failure to develop any kind of immunity. One difficulty in the study has been separation of the "gray" genes, *dd*, which result in the abnormal pups, which generally die either at birth or at a few months of age, with the "dominant gray" coat color caused by the dominant gene, *G*, which produces perfectly normal pups. The homozygous recessive *dd* pups result from two normal parents. The "dominant gray" pups must have one gray parent. Variations in effect of genes on actual phenotype further complicate the problem.

FORSTHOEFEL, PAULINUS F. The Development of Tail Anomalies Found in Mice Homozygous for the *Luxoid* Gene. *University of Detroit, Detroit, Mich., U.S.A.*

The *luxoid* gene, besides having other effects on the skeleton of the mouse, causes reduction of the centra of one or more vertebrae in the tail of homozygotes. The affected vertebrae tend to slip out of line with the remaining normal vertebrae, resulting in externally observable kinks. Sometimes adjacent vertebrae are partially fused and rarely the portion of the tail beyond a modified vertebra is missing. Study of the embryological development of the tail in *luxoid* homozygotes traced the reduction of the centra of the vertebrae to reduced somites formed during the budding of the tail. The partial fusion of adjacent vertebrae was traced to the eccentric formation of nuclei pulposi from the notochord. The eccentric formation may in turn be caused by incomplete formation of the sclerotomic fissure. Loss of the end of the tail was traced to the common formation of large blebs in the vascular system which sometimes lead to occlusion of the circulation of the tail and necrosis of the tail distal to the point of occlusion. Other anomalies found in the development of the tail were partial doubling involving notochord and somites and duplications of the nerve tube. Occasionally the duplications of the nerve tube affected higher levels of the nerve cord, including the cervical region and brain. A case of pseudencephaly observed in one *luxoid* homozygote may be related to the duplication effects on the nerve cord. (Investigation supported by a grant from the U.S. National Science Foundation.)

FOSTER, M., and L. THOMSON. The Effects of Substitution at the Leaden (*ln*) Locus on Melanogenic Attributes of the Mouse. *Yale University, New Haven, Conn., U.S.A.*

In our continuing investigation of the genetic control of mammalian melanogenesis, we have recently begun to study the effects of substitutions at the leaden (*ln*) locus in the mouse on natural melanin content, on tyrosinase and dopa oxidase activities, and on ability to darken upon *in vitro* incubation in the presence or absence of exogenous melanogenic substrates.

Although both leaden (*lnln*) and maltese dilution (*dd*) genotypes are very similar in appearance owing to clumping of pigment and reduced melanin content compared with their intense eumelanic counterparts (*Ln* or *D*, respectively), the skins of these two genotypes differ in certain metabolic and physiologic respects, especially notably on a black (*B*) background. (1) Leaden (*lnln*) black skins, while no darker than dilute (*dd*) black skins, are more active than dilute (*dd*) black skins in both enzyme activity and ability to undergo *in vitro* darkening. (2) So far, only in the leaden (*lnln*) background, in contrast to dilute (*dd*) and other backgrounds, have we observed the melanogenic superiority of black (*B*) over brown (*bb*) skins when incubated in the presence of exogenous substrate. (Work supported in part by NSF Grants G-2110 and G-5028 (Foster), by an Institutional Research Grant from the American Cancer Society, and by USPHS Grant C-2838 (Lerner).)

FOSTER, T. S. *See* STERN, HERBERT.

FOX, ALLEN S. Immunogenetic Studies in Relation to Problems of Protein Synthesis. *Michigan State University, East Lansing, Mich., U.S.A.*

On the basis of studies disclosing interaction between non-alleles, alleles, and pseudoalleles in the determination of antigenic specificity in *Drosophila melanogaster*, we have suggested that protein synthesis might be divided into two gene-controlled stages: (1) synthesis of a polypeptide pre-protein, and (2) formation of cross-linkages and folding of the chain.

Changes in X-chromosome dosage result in qualitative shifts in antigenic pattern. Comparison of XY and XO males with XX and XXY females discloses that the former possess two proteins (♂-1 and ♂-2) of distinct antigenic specificity lacking in the latter, which possess instead two proteins (♀-1 and ♀-2) of different specificity. This effect is attributable to the difference in dosage of one or more euchromatic loci on the X, possibly the sex-determining loci themselves. Some sort of interaction mechanism must be involved.

The heterochromatic Y-chromosome has no detectable effect on the antigenic specificity of proteins. However, the physical properties of a particular protein are subject to a maternal influence of the Y. When a female lacks a Y-chromosome, her progeny exhibit an antigenic specificity (Y–1) associated with a protein capable of inducing antibody formation in rabbits, capable of uniting with and precipitating specific antibody, and resistant to lyophilization. When a female possesses a Y-chromosome, her progeny exhibit the same antigenic specificity (Y–1), but it is associated with a protein incapable of precipitating specific antibody and is frequently destroyed by lyophilization, although it is capable of inducing antibody formation and of uniting (inhibiting) with the antibody. The difference would seem to be attributable to grosser features of protein structure than are concerned with antigenic specificity, which must be the product of one or more euchromatic loci.

The X–chromosome dosage effect on specificity may be associated with one of the two postulated stages of protein synthesis, and the maternal Y-chromosome influence may be with the other. Perhaps euchromatin in general is concerned with the control of protein specificity, while heterochromatin is concerned with gross protein structure (size, folding, cross-linkages, etc.), both effects being mediated by RNA. Schultz's observation that the Y-chromosome influences the type of RNA synthesized in the oocyte is probably related to these findings, and serves to connect them with the biochemical evidence that protein synthesis involves activation of amino acids by ATP, condensation of activated amino acids into a polypeptide chain presumably on an RNA template, removal of the polypeptide chain from the RNA surface, and the formation of cross-linkages and foldings.

FRACCARO, MARCO. Breeding Structure of Human Populations: Data from a Swedish Parish. *The State Institute for Human Genetics, Uppsala, Sweden.*

The parish of Ovanåker, in middle east Sweden, is a rural community; some industrial activity has however developed in recent years. Total area is 520 sq.km., 80% of it covered by forest. Communications are good with no geographical barriers. The population was 4,212 in 1900 and 7,239 in 1951. Crude migration rates show that the increase is due more to higher fertility than to immigration. Separate examination of the 1,262 marriages contracted in the period 1850–99 and the 2,098 contracted in the period 1900–44 has been made for all or part of the variables, locality of origin of the mates, geographical distance between them and frequency of consanguineous marriages.

The estimate of the frequency of marriages with at least one partner coming from another parish provides an analysis of migration of more interest than crude migration rates. This has been done for both periods 1850–99 and 1900–44 taking into account the sex of the resident partner. Of the marriages 83% are between partners both born in Ovanåker in 1850–54 but only 41% in 1900–44. No significant difference as to the sex of the resident partner is observed in the period 1850–99, while in the period 1900–44 the resident partner is more frequently the husband. The distribution of the geographical distances between partners is analysed taking into account the sex and age of the partners, and density of population at various distances. A first analysis of the distributions does not provide a simple model for the parameter "geographical distance."

The frequency of first cousin marriages is estimated at 0.57% in the period

1900–44, based on the registration of marriages over three generations. Distribution of a rough estimate of geographical distance between partners of these marriages has been obtained. The genetic implications of these demographic data are discussed.

FRANZKE, CLIFFORD J. *See* ROSS, JAMES G., *et al.*

FRANKEL, O. H., RUTH GANI, and ANNE MUNDAY. Two Independent Gene Systems for Floral Induction in Wheat. *Division of Plant Industry, Commonwealth Scientific and Industrial Research Organization, Canberra, Australia.*

The lowest two (or three) florets in each well-developed spikelet of *Triticum vulgare* are invariably fertile; but in a series of speltoid mutants with progressive basal sterility, the lowest one, two or three flowers are reduced or missing. Fertility is restored by re-introducing the "vulgare inductor": all *T. vulgare* types in crosses mutant × *T. vulgare* are normal. Flower development in *T. vulgare* is thus activated by a single dominant fertility inductor (I^+) which most likely is part of the *T. vulgare* inductor, Q.

There is, however, a second system for flower induction in *T. vulgare,* revealed in the absence of I^+ (and Q), i.e. in speltoids. Induction of the lowest flower requires 3 genes, of the next a fourth, of the third at least a fifth; these are minimum assumptions. One is dominant for fertility, the rest have no dominance. Of the *T. vulgare* tested, 4 carry at least 1 (1 of them 4) sterility alleles. Presumably there are further genes, and higher sterility grades; speltoids with only an occasional grain in spikelet tips occur.

We thus find 2 gene systems: one monogenic, with dominance, part of a "supergene" of vital significance; the other polygenic, without clear dominance, distributed, cryptic in action. The polygenic system has no obvious effect on fertility in *T. vulgare;* but *T. vulgare* carrying four sterility alleles exhibits a trace effect of flower reduction.

Since the monogenic system performs the function effectively, why does the polygenic system exist? (1) The polygenic system may have pleiotropic effects of which there is no evidence. (2) The monogenic system may be a recent acquisition, the polygenic an older system, now in disuse and removed from effects of selection. If, according to McFadden and Sears, Q (hence probably I^+) was transferred from a free-threshing Lake Dweller wheat to *T. spelta* in historical times, the former brought the monogenic, the latter the polygenic system. Whatever the origin, the evidence suggests that the monogenic system took charge and the polygenic system is in a degenerative state.

FRASER, A. S., and R. B. DUN. Selection for an Invariant Character "Vibrissa Number" in the House Mouse. *Commonwealth Scientific and Industrial Research Organization, Animal Genetics Section, Zoology Department, Sydney University, Sydney, Australia.*

"Vibrissa number" in the house mouse is scored by addition of the number of vibrissae in the five minor groups found on the head and fore-limbs of the mouse—

a total of 19 vibrissae. Inbred lines A_w101 and CBA showed no variation in "vibrissa number" and a parent stock based on these two lines was used in an attempt to break down the invariant vibrissa development.

In order to produce phenotypic variance in "vibrissa number," the sex-linked, semi-dominant gene Tabby (*Ta*) was crossed into the selection stock. The average "vibrissa number" in (*Ta*+) females and (*Ta*) males is 15.1 ± 1.9 and 8.7 ± 1.6. High and low lines were established by selecting within this uncovered variance and in seven generations the selection lines have been separated four standard deviations (Ta+ female score).

The first wild-type mice with low "vibrissa number" appeared in generations 5 and 6 of the low selection line and four of these mice had lost a post-orbital vibrissa—a site which was found to be invariant in an examination involving 6,000 mice. In generation 6, four mice with increased vibrissa number appeared in the high line. Three of these mice had an extra supra-orbital vibrissa and one mouse had four inter-ramal vibrissae.

These results show, first, that there is genetic variation in vibrissa development which is not apparent in unselected mice in the absence of *Ta*. Secondly, it has been possible to breed wild-type mice with both more or less than the standard number of vibrissae by selecting within the variation which becomes apparent when *Ta* is introduced. Although the genetic basis of these changes is unknown, it seems reasonable to suggest that the polygenic system controlling vibrissa development has been altered by selection.

FRASER, F. C. *See* TRASLER, DAPHNE G.

FREESE, ERNST. Specific Mutations of Phage T4 Induced by Isoadenine. *Biological Laboratories, Harvard University, Cambridge, Mass. U.S.A.*

An understanding of mutagenesis on the molecular level requires the correlation of genetically localized mutations with well-defined chemical changes in the hereditary material. Among the large number of mutagens, those chemicals are of special importance which produce a specific and localized chemical change on DNA. Especially promising are those base-analogues which can be built into DNA instead of a normal base. The structural model of DNA, presented by Watson and Crick, suggests that only those base-analogues can be mutagenic, by direct incorporation into DNA, which are able to form at least two hydrogen bonds with either of two normal DNA bases. A given purine analogue, for example, is expected to compete readily with one of the normal purines for incorporation into DNA; however, rarely it may behave like the other normal purine and pair in its place with the complementary pyrimidine. Each of these rare pairings alters the normal sequence of DNA nucleotides and causes a mutation. The mutation frequency is greater than that of spontaneous mutations if these mistakes occur much more frequently than the spontaneous mutations. Such a direct mutagenic action of a base-analogue is possible only if it can be converted by the enzyme system present in the cell into the direct DNA precursor. Applying these considerations as well as using the partially known steric requirements of those enzymes which are responsible for the production of DNA precursors, a small number of base-analogues have been selected and tested for their mutagenicity. It was found that 2-aminopurine (= isoadenine) exerted a strong mutagenic effect upon phages T4. A large number of independent (*r*) mutants of T4 have been isolated and genetically mapped. The fine structure mapping within the *r* II cistron showed that sites of high mutability exist which are different from the ones found among spontaneous *r* mutants. One of these sites coincides with one of the sites of high mutability among the *r*-type mutants induced by Bromouracil while the other sites are different. The significance of these results will be discussed.

FREIRE-MAIA, A., N. FREIRE-MAIA, and A. QUELCE-SALGADO. Genetic Aspects of Achiropody. *Laboratory of Genetics, Faculty of Philosophy, University of Paraná, Curitiba, Paraná, Brazil.*

Only one instance of familial achiropody has been reported in the genetic literature (Peacock, Eug. News *14*: 46–47; Tucker, Eug. News *15*: 59–60; Cook, Eug. News *15*: 86–87; and Bohomoletz, Eug. News *15*: 143–145. Owing to the extreme rarity and highly mutilating effects of the condition this family has been widely cited. Since the information available conflicts in some extremely important points, we have reinvestigated the family. An autosomal recessive gene was probably responsible for the anomaly, rather than a dominant gene as proposed in the earlier hypothesis.

Six other families with at least one case of achiropody have been located in several Brazilian states, and it has been possible to study them. A full analysis of the problem, including the radiologic and dermatoglyphic aspects, will be published later in collaboration with Dr. R. A. Koehler and Dr. J. Lejeune.

Study of the seven families (including the first one) established the following facts: (1) All the abnormals have normal parents. (2) Three couples are consanguineous (one being uncle and niece, and the others first cousins), an incidence of consanguinity equal to 43% (3 out of 7). Taking the abnormals as the basis for calculation, 65% of them have consanguineous parents (13 out of 20). These frequencies are respectively 15 and 22 times those estimated for the Brazilian general population (cf. Freire-Maia, Am. J. Hum. Gen. *9*: 284–298). (3) The sex ratio among the abnormals is equal to .70 (14/20). Among their normal sibs it is .60 (21/35). The difference between the 2 values is not significant ($x^2 = .55$; $P > .30$). (4) The relation of 20 abnormals to 35 normals, verified among the children of the 7 families, agrees with the Mendelian ratio of 3:1, when duly corrected. The "sib method" leads to the ratio 13:35, for an expected ratio 12:36 ($x^2 = .11$; $P > .70$). According to the "*a priori* method," the expected number of abnormals is 15.65 ± 2.88. (5) The viability of the abnormals is not lower than that of their normal sibs, as measured by survival until 18 years of age. The frequency of the abnormals among the children born is 36% (20 out of 55), and increases to 43% among the children who attained at least 18 years of age (10 out of 23). The frequency of abnormals and normals at least 18 years old in comparison with the number born in each class equals .50 and .37, respectively. These differences, which actually favor the abnormals, are not significant ($x^2 =$ .35 for the first comparison and .86 for the second one). At more advanced ages, the same conclusion seems true, but as the number of people decreases rapidly with age, any statistical analysis would be of dubious value. (6) None of the 20 abnormals had children. (7) Our data do not permit a reasonable estimate of the prevalence of the anomaly in Brazilian populations, but it may be classed as very rare, taking as a standard the prevalences calculated up to the present for the majority of genetic anomalies.

Aspects (1) to (4) show that achiropody is due to an autosomal recessive gene. Although the viability of the abnormals does not seem to be different from that of the normals (5), inasmuch as our data do not show any case of reproduction (6), the frequency of the anomaly is probably being maintained in populations by recurrent mutation. As it is a very rare anomaly (7) the achiropody gene probably has an extremely low mutation rate. (This investigation was supported by grants from the Research Institute of the Faculty, the National Research Council of Brazil and the Rockefeller Foundation.)

FREIRE-MAIA, N., and A. FREIRE-MAIA. Effects of the Structure of First Cousin Marriages on the Coefficient of Inbreeding for Sex-linked Genes in Brazil. *Laboratory of Genetics, Faculty of Philosophy, University of Paraná, Curitiba, Paraná, Brazil.*

First cousin marriages may be subdivided into four types (A,B,C,D), according to the sex of the spouses' parents through whom consanguinity occurs. Type A represents relationship through two sisters ($f' = 3/16$); type B, through the wife's father and husband's mother ($f' = 1/8$); type C, through husband's father and wife's mother ($f' = 0$) and type D, through two brothers ($f' = 0$) (*cf.* Haldane and Moshinsky, Ann. Eug. *9*: 321–340; Wright, Ann. Eug. *15*: 323–354). In a population where the four types occur with equal frequencies, the mean f′ (f'_m) would be equal to 5/64 or 0.078125, i.e., a value 25% higher than the coefficient f for autosomal genes (1/16 or 0.0625). Any social system favoring one or some of the above types will produce changes in the values of the population coefficient F′ for sex linked genes.

Data obtained in "primitive" as well as in "modern" populations show that equality of the four types of cousin marriages ($\bar{A}=\bar{B}=\bar{C}=\bar{D}$) rarely occurs. In Europe and Japan, for instance, recent data show an excess of the classes A and B (system leading to an increase of F′); the opposite has been detected in India. Preliminary information obtained in two Brazilian populations showed that in one of them the distribution was different from that prevailing in Europe (Freire-Maia, in press, 1958). The analysis has been extended to seven other populations (Dioceses of Petrolina, Pe, and Pesqueira, Pe, in the Northeast; and Salvador, Ba, Barra, Ba, Belo Horizonte, MG, Campanha, MG, and Vitória, ES, in the East), and new data for São Paulo, SP, as well as those previously published for São Paulo and Curitiba, Pr (both of them in the South), have been included. These populations present differences in ethnic composition, economic basis, level of literacy, degree of isolation, etc. The data have been obtained through analysis of ecclesiastical files and so represent only Roman Catholic marriages, which are the great majority of all marriages.

An analysis of the data for the nine dioceses leads to the following main conclusions: (1) The samples from three dioceses (Pesqueira, Salvador, and Petrolina) show significant differences in the frequencies of the four types of first cousin marriages. As the differences reveal an excess of the types with $f' = 0$, the net result is a decreasing (respectively 2, 6, and 11%) in the values of f'_m. However, f'_m for the total data is still greater than the value of f (0.0625). (2) Type

D, with $f' = 0$, which occurs with a relatively low frequency in Europe and Japan, is one of the two most frequent in 10 out of the 11 samples analysed in the total, and in 8 out of the 9 recent ones. As a matter of fact, type D is the most frequent in 6 out of the recent 9. $C + D$ is more frequent than $A + B$ in 6 of them. The influence of these facts on the value of f'_m in the samples not referred to in the last paragraph is also small, the decreases being between 1 % and 12%. (3) Four samples (two from São Paulo, one from Belo Horizonte, 1922, and one from Campanha) present a distribution of the "European" type ($A + B > C + D$) and have, therefore, values of f'_m higher than those theoretically expected on the assumption of random mating. This increase is respectively 14 %, 8%, 16%, and 11%.

These variations in the values of f'_m are expected to have small effects on the population make-up if one uses as a standard the theoretical value 0.078125. Comparing, however, populations with relatively high values of f'_m (such as 0.08875, found in São Paulo) to populations characterized by relatively low values (such as 0.069137, found in Curitiba), somewhat larger effects are naturally to be expected. (This investigation was supported by grants from the Research Institute of the Faculty, the National Research Council of Brazil and the Rockefeller Foundation.)

FREIRE-MAIA, N. *See* FREIRE-MAIA, A., *et al.*

FRYE, SARA H. An Analysis of Minute Rearrangements of the Yellow Region in *Drosophila melanogaster. Indiana University, Bloomington, Ind., U.S.A.*

Minute rearrangements involving the left end of the X-chromosome of *Drosophila melanogaster*, having the scute-8 inversion, and the yellow-bodied exceptions were analysed genetically. Analysis confirmed that this region in this chromosome contains the following genes (among others) in the sequence here given: lethal J1$^+$ (*l*J1$^+$), lethal F$^+$(*l*F$^+$), yellow$^+$(y$^+$), achaete$^+$(ac$^+$), bobbed$^+$(bb$^+$). Tabulation of the frequencies of the radiation-induced cases thus far analysed, the loci of the respective + (indicating the normal allele) and — (indicating the recessive mutant allele or deficiency) signs are represented by their position in the above given sequence: — — — — — (26), — — — — + (118), — — — + + (0), + — — — — (0), + + — — — (1), + — — — + (1), + — — + + (3), + + — — + (12), + + — + + (7).

In addition, there were 32 cases with lethals or detrimentals in the euchromatic region to the right of bb$^+$ which are still under analysis. Of these 32, 18 are — — — — — *l*, 11 are — — — — + *l*, and 3 are + — — — + *l*.

Of the 173 cases involving losses of tested loci to the left of and including yellow$^+$, fifteen have been found to be capped by the right end of the II (8) or IV (7) (the only ends available for more precise testing). Of these 15 capped X-chromosomes, all are ac$^-$, 6 are bb$^+$ and 9 are bb$^-$.

There were 3 spontaneous minute rearrangements, all were — — — — +.

The frequency of all exceptions combined are for 4000 r in relation to total count 126/41,310 and 1000 r 148/180,942 and spontaneous 7/263,694. Distribution of these exceptions in relation to dose will be presented.

(Work supported by a grant to H. J. Muller and associates from U.S. Atomic Energy Commission, Contract AT(11–1)—195.)

FUJII, KENJI. *See* YUASA, AKIRA.

FULLER, J. L., and J. P. SCOTT. A Ten-Year Experiment on Heredity and Behavior in Dogs. *Roscoe B. Jackson Memorial Laboratory, Bar Harbor, Maine, U.S.A.*

A wide variety of behavioral tests were administered to dogs of five pure breeds. Breed differences were demonstrated on most measures, whether of emotionality, learning, or specific behavior patterns. Hybrids between basenji (the African barkless dog) and cocker spaniels were also studied in order to determine genetic mechanisms. A demonstration will illustrate the plan of the experiment and summarize the results of selected tests.

FULLER, JOHN L. *See* SCOTT, J. P.

FUNG, SUI-TONG, JANICE STADLER, and JOHN W. GOWEN. Sex Differentiation as Affected by Major Genes and Gene Dosages. *Genetics Department, Iowa State College, Ames, Iowa, U.S.A.*

In *Drosophila*, adult sex is a consequence of integration of four and likely more cell systems. The sex combs are a part of the anteriorly located first leg discs, the gonads are mid-posterior, the genital disc is the last abdominal segment and body sizes are inclusive of whole animals. Cells susceptible to specific sex development are located in widely separated body regions. Sex mosaics show that the embryological field is under local control. Duplication of male or female secondary sexual systems in single individuals occasionally appears. In rare cases a full male reproductive system including testis and full reproductive tract may accompany a complete female tract including ovary. With polyploidy Bridges observed some six major distinguishable types; male extremes $X + 3A$ and $X + 2A$, intersexes $2X + 3A$ and female extremes $2X + 2A$; $3X + 2A$ and $3X + 3A$. Female-influencing genes of the X chromosomes were held to balance male-influencing genes of the autosomes in evolving these types. Possible deficiencies in technique have thus far prevented demonstration of specific chromosome regions in the wild types which play specific roles in these reactions. Mutation, however, has shown that male-influencing regions exist in the autosomes in *D. virilis* (Lebedeff, 1939, and Newby 1942); in *D. melanogaster* (Gowen, 1942; Sturtevant, 1945; and others). These autosomal genes convert females into specific types of males or intersexuals. Melanogaster genes form an allelic series, F_1 progeny showing specific types traceable to the joint actions of both mutants. With polyploidy some ten types are known. They are not mosaics in time. Gene *Hr* causes the joint appearance of both male and female organs developed from the genital disc. Sturtevant's *tra* when homozygous retains the female body size while causing the gonads, genital disc and sex combs to develop fully male type. Sex comb variation in *Hr* types have characteristic variances similar to other characters. Contributions of dominance and epistacy as they operate in the embryological fields susceptible to sexual development are measurable and will be discussed. (This work has received assistance from Contract No. AT(11–1)107 from the Atomic Energy Commission.)

FURUHATA, TANEMOTO, and NORIO HAYASHI. Distribution and Inheritance of the Ear-Wax Type. *Department of Legal Medicine, Tokyo Medical and Dental University, Tokyo, Japan.*

It has been recognized that there are two types of ear-wax among human beings; one is gray, brittle and dry, the other blackish brown, yellowish brown, sticky and wet. The former is called the dry type and the latter is called the wet type. These two types are considered to be normal hereditary traits.

The authors have investigated the distribution of ear-wax type in 3,403 individuals in the Tokyo metropolitan area and found that the wet type occurred at a rate of 15.52%. This rate is somewhat different from previous reports.

According to the previous investigators this difference is due to differences of age and of areas tested for distribution.

The present investigation, in some cases, shows different rate of the frequency of each type by the determination between the two types of ear-wax.

The authors have investigated 950 families and confirmed that the wet type of ear-wax is inherited as the Mendelian dominant. This classification of ear-wax can be used in the analysis for cases of disputed paternity.

GAJEWSKI, W. The Relation between Age of Geographical Disjunction and the Degree of Differentiation in *Geum hispidum* Fr. *Botanic Gardens, University of Warsaw, Warsaw, Poland.*

Geum hispidum Fr. was discovered by Fries on the southeastern coast of Sweden. Plants similar to *G. hispidum*, found in Spain, were described as another species *G. albarraciense* Pau. On the Balkan Peninsula another species *Geum molle* Vis. et Panc. is known which is closely related to *G. hispidum*. We have thus three populations of plants morphologically closely related but geographically widely separated. The disjunction between the Balkan and Spanish populations is probably old, dating from the late Tertiary, whereas that between the Spanish and Swedish populations must be very new as the southeastern coasts of Sweden emerged from the sea only late in postglacial times. *G. hispidum* was probably introduced by man from Spain into Sweden. It is thus possible to compare the cytogenetic relationships among plants from these three populations in relation to the duration of the isolation period.

Plants from these populations were grown in Warsaw and their cytogenetic and morphological differences were analysed. All plants have 42 somatic chromosomes. The chromosomes are homologous, but in hybrids between *G. molle* and *G. hispidum* few univalents were found. The morphological differences between *G. molle* and *G. hispidum* are small but distinct. Those between Swedish and Spanish *G. hispidum* are barely perceptible. F_1 hybrids are intermediate and in F_2 generations the parental traits show continuous segregation. The more sensitive test for differentiation was hybrid fertility. The pollen and seed fertilities of the hybrids *G. molle* × *G. hispidum* were lowered to about 50% level, whereas in hybrids between Swedish and Spanish plants the pollen fertility was quite normal and seed fertility decreased about 15%. It may be concluded that in older disjunction the differentiation has proceeded to a stage which can be accepted as one of species, whereas in the more recent disjunction the differences are at the most of the variety rank.

GALINSKY, IRVING. Abnormal Chromosome Movement Resulting from the Realignment of the Polar Forces. *Biochemical Research Foundation, Newark, Delaware, U.S.A.*

The effects of "mitotic poisons" upon the polar forces or centers in the cell have generally been obscured by their more striking effects of the inhibition of the spindle and failure of the chromosomes to move to the poles. In normal mitosis there is a centralization of forces at the two poles and these are responsible for the equal distribution of anaphase chromosomes to the poles. "Mitotic poisons" as simple as inorganic phosphate when used in appropriate concentrations upset the balance of polar forces and result in abnormal distribution of anaphase chromosomes. The strength of the poles is changed to a remarkable degree and this is manifested by the proportion of anaphase chromosomes which move to the poles. A single pole may be so weak that it attracts only a few chromosomes or so strong that all chromosomes move towards it. The movement of the poles themselves can be changed and instead of moving to opposite ends of the cells, the poles may remain very close together.

A most unusual phenomenon occurs after the breakdown of the nuclear membrane. The spindle does not appear to function and the metaphase chromosomes are not oriented on an equatorial plate. After the kinetochore splits, the spindle may begin to function and the anaphase chromosomes may move to the poles. The chromosomes move at different rates and some may begin their movement after the others have already reached the poles.

The wide range of abnormal chromosome distributions which occur during phosphate treatment indicates that a number of phases are involved in the formation and action of the spindle apparatus upon which the phosphate can act. The earlier the stage of mitosis present when the phosphate acts, the greater the disruption of the mitotic processes.

GANI, RUTH. *See* FRANKEL, O. H., *et al.*

GARBER, EDWARD D. The Genus *Collinsia*: Cytotaxonomy and Speciation. *Department of Botany, University of Chicago, Chicago, Ill., U.S.A.*

The genus *Collinsia* Nutt. (Scrophulariaceae) includes twenty-one recognized species, mostly restricted to the Pacific coast states. The genus is divided into two major groups, depending on whether the flower pedicel is longer than or as long as to shorter than the calyx. The basic chromosome number is seven. Only a single polyploid species, *C. torreyi* ($2n = 42$) has been found; three species have not yet been studied. Seven species are included in the group with short pedicels, five species having a lower mean number of chiasmata per bivalent at metaphase I compared with either of the other two species in this group or with the species in the other group. It has been possible to detect subgroups of one or more species on the basis of morphology, crossability between species, and the cytology of interspecific hybrids. Within a subgroup interspecific hybrids yield only bivalents; between subgroups interspecific hybrids yield such aberrations as heterozygous reciprocal translocations and heterozygous paracentric inversions. The former hybrids have greatly reduced fertility; the latter are completely sterile. The following working hypothesis for speciation in *Collinsia* has emerged: (1) chromosomal repatterning, followed by (2) mutation, and (3) much less significant, polyploidy. (Supported by the National Science Foundation and the Abbott Memorial Fund, The University of Chicago.)

GARTLER, STANLEY M. An Investigation into the Biochemical Genetics of B-aminoisobutyric Aciduria. *Division of Medical Genetics, School of Medicine, University of Washington, Seattle, Wash., U.S.A.*

This paper reports an investigation into the metabolic mechanism by which a genetic difference results in differential excretion of B-aminoisobutyric acid (BAIB). Two general hypotheses are examined in this respect: (1) differential renal function, and (2) differential thymine metabolism, a known precursor of BAIB. The data presented show that BAIB is not readsorbed by the renal tubules in either genetically determined high or low excretors of BAIB, which disposes of the renal hypothesis. Differential thymine metabolism is examined from three viewpoints: differential thymine synthesis, differential reductive catabolism of thymine, and differential metabolism of thymine via an alternative (e.g., oxidative) but unspecified pathway. The combined data strongly support the hypothesis that differential metabolism of thymine via an alternative pathway is the underlying factor in B-aminoisobutyric Aciduria, and that this system indirectly gives rise to the observed variation in urinary BAIB excretion.

GAWRONSKA, EVA M. S. *See* HSIA, DAVID YI-YUNG.

GERALD, P. S., and L. K. DIAMOND. Evidence for an Etiologic Differentiation of Dominantly and Recessively Transmitted Methemoglobinemic Cyanosis. *Children's Medical Center and Department of Pediatrics, Harvard Medical School, Boston, Mass., U.S.A.*

A series of experiments have been conducted on the blood of a representative member of a family exhibiting dominantly transmitted methemoglobinemic cyanosis. Electrophoresis of the oxidized hemoglobin was successfully used to separate the hemoglobin into a normal and an abnormal fraction. The abnormal fraction was found to have spectroscopic properties resembling those described by Hörlein and Weber in their investigation of a cyanotic condition likewise transmitted as a dominant characteristic. Since this abnormal hemoglobin differs from the normal in the globin portion of the molecule, its inclusion among the group of abnormal hemoglobins is justified and the designation Hgb M has been adopted. The dominant mode of transmission is thus in accordance with the common abnormal hemoglobin syndromes. The presence of Hgb M may be suspected in cases of hereditary cyanosis in which excessive amounts of reduced hemoglobin are absent and there is difficulty in the detection of methemoglobin by spectroscopic or chemical tests. A review of the recorded cases indicates that most instances of dominantly transmitted methemoglominemic cyanosis can be attributed to Hgb M disease. The recessively transmitted forms on the other hand have been associated with spectroscopically normal methemoglobin. The confusion surrounding the inheritance of methemoglobinemic cyanosis undoubtedly results from the existence of at least two etiologically distinct forms of the disease, (*a*) that associated with normal methemoglobin, and (*b*) that associated with the methemoglobin form of Hgb M.

GERASSIMOVA-NAVASHINA, HELEN. Mitotic Hypothesis of Double Fertilization in Angiosperms. *Botanical Institute of the Academy of Sciences of the USSR, Leningrad, U.S.S.R.*

The greatest riddle of Double Fertilization consists in the fact that the two sperms, after having entered the embryo sac together, subsequently separate, moving in diametrically opposite directions; each of them penetrates into one of the two female cells (ovule and the central cell) and finally unites with its nucleus. It has been shown that this phenomenon cannot be attributed to cytoplasmic currents carrying the sperms but must rather be due to the very nature of the sperms themselves as well as to their interaction with the peculiar surroundings existing in the female sphere.

Careful studies made by the author have convinced her that the process of fertilization is governed by certain basic principles inherent in any living cell. These principles primarily concern movements of chromatids and sister nuclei at mitosis as well as movement and localization of nuclei under varying conditions arising in cells without mitosis. It appears therefore that the fertilization process may be analyzed only on the basis of a study of the development of the reproductive elements. The female sex cells attain a state of a profound mitotic rest and may be normally brought out of it only by the influence of the male fertilizing system. The sperms, on the other hand, owing to peculiar developmental conditions, remain in a state of incompleted mitosis (telophase) and cannot accomplish their developmental cycle without the female cells, the final resting stage being attained as late as in the zygote. The very movement of the sperms may be interpreted as mutual repulsion of the two sister nuclei—a phenomenon of the sort invariably observed in any mitosis; it is especially pronounced during spermatogenesis. The reason for the oriented character of this repulsion is seen by the author in the fact that the pair of sperms is delivered by the pollen tube just in the region between the two female cells in which, owing to an interaction of their nuclei, there exists a sort of cytoplasmic polarization (which is not unlike a secondary spindle or perhaps simply represents a relic of the preceding mitotic activity which produced the two female sister cells in question). This cytoplasmic orientation directs the motion of the sperms towards the opposite female cells. After having entered a female cell, the sperm, like any nucleus, is drifted to the dynamic centre of the said cell where the female nucleus is already found. Here occurs an interaction of the sperm with the female cell; this process results in resting condition of the sperm (formation of a nucleolus and loss of deoxyribonucleic acid), i.e., in the completion of its mitotic cycle under the influence of the resting female cell. The contents of the pollen tube in its turn brings the female cell out of rest and induces the zygotic mitosis, i.e., the initiation of a new ontogenesis.

One may thus assume that double fertilization rests upon mitosis which becomes singularly distributed in space and time and assumes various forms according to specific conditions influencing the development of the female and male sex elements. The development of the zygote may be interpreted therefore as a solution of controversy created by the contrasting properties of the elements of opposed sexes assumed by them owing to the profound differences of their developmental conditions.

GERSHOWITZ, HENRY, and LEE E. SCHACHT. An Examination of the Correlation between Human Blood Types and Potentially Fatal Diseases of Children. *Department of Human Genetics, University of Michigan, Ann Arbor, Mich., U.S.A.*

A large body of evidence has arisen in recent years purporting to demonstrate the possible physiological effects of the genes determining the blood groups; more specifically, the ABO blood groups. The physiological correlations thus far demonstrated have, for the most part, been found in adults who are either in or past their reproductive years and do not appear to provide an adequate explanation for the existing blood group polymorphism. This study was devised to determine whether any correlations exist between blood groups and certain fatal or potentially fatal diseases of children. These diseases constitute a possible selective force which has not been sufficiently explored.

Children ranging in age from birth to 14 years, ascertained through the University Hospital and Children's Hospital of Michigan in Detroit, were selected as propositi on the basis of the following diagnoses: rheumatic fever, nephritis and nephrosis, leukemia, meningococcemia, congenital heart disease, hydrocephalus, and hemolytic anemia. Blood and saliva samples were obtained from all propositi, full sibs, and parents. This report concerns the results so far obtained on three of the study diseases; nephritis and nephrosis (55 families), leukemia (56 families), and congenital heart disease (42 families). As yet, no deviations from the normal population frequencies have been found among the propositi for any of the seven blood group systems studied. The results of the sib comparisons will also be presented.

(This project was supported, in part, by Grant AT(11–1)–405 from the U.S. Atomic Energy Commission.)

GIBBONS, I. R. Observations on the Fine Structure of Nuclei and Chromosomes in Locust Testis. *Cavendish Laboratory, Cambridge, England.*

Electron microscopic studies on thin sections of locust testis have not yet been able to elucidate all the changes of chromosomal organization that occur during the division cycles of mitosis and meiosis. However, at certain stages of development characteristic fine structure has been observed in chromosomes. The fine structure that has been observed in chromosomes of meiotic prophase, and that in nuclei of spermatids will be briefly described in this paper. Some evidence (Gibbons and Bradfield, Biochim. Biophys. Acta *22*: 506) suggests that further improvements in preparative techniques will be needed for a more complete elucidation of chromosomal fine structure.

Sections of locust spermatocytes show that during the early to middle diplotene stages of meiotic prophase the chromosomes contain a pair of dense fibrils, each about 250Å in diameter, running parallel to the long axis of the chromosome. These fibrils usually appear to run parallel to each other and 700Å apart (centre to centre); they have occasionally been observed twisted around each other in a very loose spiral. In some preparations there appears to be a third fibril running midway between the two fibrils described above; this central fibril is thinner (about 100Å in diameter), and less well-defined than the outer pair. All of these fibrils taken together form only a very small part (of the order of 0.5% by volume) of the chromosomal substance and their relationship to the rest of the chromosome remains obscure.

In the nuclei of locust spermatids the whole of the chromatin becomes oriented into a large number of closely packed, elongated, narrow tubes that run parallel to each other and to the long axis of the spermatid (Gibbons and Bradfield, J. Biophys. Biochim. Cytol. *3*: 133). These tubes have a dense wall about 60Å thick; their over-all size is variable and decreases as the spermatid matures. In very late spermatids and mature sperm this oriented structure is no longer visible in electron micrographs—perhaps because it has become too closely packed. The appearance of the complex tubular structure in the chromatin of the nuclei can be correlated with the appearance of bi-refringence in the nuclei (Pattri, Zeit. Zellforsch. *16*: 723) and with the change in the chemical nature of the protein component of the nucleoprotein (Felix *et al.*, Progress in Biophysics *6*: 2) that occur during the formation of the mature sperm.

GILES, NORMAN H. *See* CHU, ERNEST H. Y.

GILMORE, L. O. *See* FECHHEIMER, N. S.

GINOZA, W. *See* SIEGEL, ALBERT, *et al.*

GLASS, BENTLEY, and L. E. METTLER. The Oxygen Effect in Respect to Point Mutations in *Drosophila melanogaster*. *Department of Biology, Johns Hopkins University, Baltimore, Maryland, U.S.A.*

Baker and Edington (1952) demonstrated that the frequency of sex-linked recessive lethals induced by X-rays in *Drosophila melanogaster* varies with the oxygen concentration at treatment, particularly at concentrations below that of air. At a dose of 4000 r about a doubling of the frequency of lethals was obtained. It is generally recognized, however, that a certain proportion of X-ray induced lethals are associated with chromosome breakage; and since essentially all other evidence relating to the oxygen effect in various organisms has applied to the frequency of chromosome breakage and reunion, it has remained uncertain whether or not the oxygen effect applies to point mutations.

Larvae 80 hours old (total age 120 hr.) possess germ cells in pre-meiotic stages only, and the frequency of chromosome aberrations recoverable from such cells is very low in the male germ line and seems to be zero in the female germ line. A representative sample of recessive lethals induced in irradiated 80-hour-old larvae of both sexes was examined cytologically. Of 35 lethals induced in male germ cells, 1 was in a chromosome carrying 3 breaks; no other lethal was associated with any detectable breakage in the X-chromosome. Of 31 sex-linked lethals induced in 80-hour-old female larvae, none showed any chromosome breakage. Minutes, which frequently arise in connection with small deficiencies, are unobtainable from X-ray treatment of larval females.

Larvae 80 hours old were irradiated (2,000 r) in nitrogen, air, and pure oxygen. Although no significant difference was found between those irradiated in air and in oxygen, there was a significantly lower frequency in both sexes when irradiated in nitrogen than when irradiated in air. The frequency of lethals was consistently lower in the female series than in the male series; but the magnitude of the oxygen effect (approximately a doubling in frequency) was very similar in both. It may be concluded that the oxygen effect applies to point mutations as well as to chromosome breakage and reunion.

GLASSMAN, E., J. L. HUBBY, and H. K. MITCHELL. Maternal Effect of *ma-1*$^+$ in *Drosophila melanogaster. Department of Biochemistry, City of Hope Medical Center, Duarte, Calif.; Zoology Department, University of Texas, Austin, Texas;* and *Biology Department, California Institute of Technology, Pasadena, Calif., U.S.A.*

Previous work (Genetics *42*: 372) has shown that maroon-like (*ma-1*) and rosy (*ry*) eye color mutants of *Drosophila melanogaster* are deficient in xanthine dehydrogenase. Consequently, there is an accumulation of the substrates of this enzyme (hypoxanthine and 2-amino-4-hydroxypteridine), while the products formed from these compounds (uric acid and isoxanthopterin, respectively) have not been detected in these strains. Recent studies have shown that the genetically *ma-1* progeny from *ma-1*$^+$/*ma-1* or *ma-1*$^+$:= (attached-X) females are unexpectedly wild type in eye color; *ry*$^+$/*ry* females do not produce such "wild-type" offspring. Further studies have shown that these "wild-type" progeny are due to a maternal effect (pre-determination) of *ma-1*$^+$. However, only flies which emerge in the first 6 to 10 days of hatching show this effect; those which emerge later in the bottle have the typical *ma–1* eye color. This is due to a change in the food and not to the age of the female parent, since old females transferred periodically to new food will have maternally affected progeny in each new bottle. Biochemical studies have shown that in addition to increased amounts of red eye pigment, the maternally affected offspring have traces of isoxanthopterin and uric acid (the enzyme products), and do not accumulate as much hypoxanthine and 2-amino-4-hydroxypteridine (the enzyme substrates) as normal *ma–1* flies. This could indicate that small amounts of the enzyme have been passed through the egg, but no enzyme activity in extracts of these flies has been detected. Most maternal effects of this type affect processes in the egg, but the effect here seems to be much later.

GLAVINITCH, ROUJITZA. A, Transformation des blés d'hiver en blés de printemps héréditaires; B, Changement de l'hérédité chez le cotonnier. *Faculté Forestière, Belgrade, Yougoslavie.*

(A) D'après la théorie de développement par stades de T. D. Lisenko nous avons réussi, au cours de la période allant de 1947 jusqu'à 1950, par le changement du complexe des facteurs extérieurs (températures, lumière) à transformer la variété de blé d'hiver héréditaire "Kooperatorka" en variété de blé de printemps héréditaire. (B) Au cours de la période allant de 1949 à 1954 nous avons réussi, par le changement des conditions extérieurs (les températures basses, etc.), à changer l'hérédité de la variété de cotonnier Big-Boll (de l'Amérique du Nord) à longue période de végétation et à obtenir une variété nouvelle "Makedonka," qui donne des fibres de qualité, a une courte période de végétation, et réussit bien dans les régions à cotonnier de Yougoslavie.

GLENK, H. O. *See* SCHWEMMLE, JULIUS, *et al.*

GOLDSCHMIDT, ELISABETH. Cryptic Genetic Factors Changing Pterine Concentrations of *Drosophila* Eyes. *Department of Zoology, The Hebrew University, Jerusalem, Israel.*

A stock of *Drosophila melanogaster* homozygous for the ey^2 gene differs in the concentrations of several pterines from the normal laboratory strains Berlin and Canton S. The fluorescent substances affected include F1 3 (isoxanthopterine), F1 4 (= F1 4A : 2-amino-4hydroxy-6-(1′,2′-dihydroxypropyl)-pteridine and F1 4B : 2-amino-4hydroxypteridine), F1 5 (probably 2-amino-4-hydroxy-7, 8-dihydro-8-lactylpteridine-6-carboxylic acid) and F1 7. (Identification of pterines based on Forrest and Mitchell, 1955, J. Am. Chem. Soc.: 77, and on Viscontini *et al.*, 1955, a, b, c, Helvet. chim. Acta: 38.) For convenience the changed pattern was characterized by the altered ratio of the fluorescent spots F1 5/ F1 4 (A & B), calculated from their fluorometric values after two-dimensional development of squashed heads and subsequent elution in water. With the colour filters utilized (366μm. and 440μm.) this ratio is always larger than 1 (1.5—2.5) in the normal strains and invariably below 1 (0.5—0.8) in the ey^2 under investigation. The "altered ratio" behaves autonomously in ey^2 eyes transplanted into normal hosts.

It could, however, be shown that the altered F1 5 / F1 4 ratio is by no means characteristic of all flies homozygous for the ey^2 gene. In an attempt to transfer the fourth chromosome of the *ey* stock to a background of chromosomes of the Berlin strain, *ey* flies were backcrossed for 54 generations to Berlin. The resulting *ey* flies show a partially normalized F1 5/ F1 4 ratio, approaching one and differing significantly from both that of Berlin and that of the original *ey* stock. A more complete normalization of the ey^2 chromatogram was achieved by transferring the fourth chromosome of the *ey* strain to a background of Berlin chromosomes in a system of crosses utilizing the well-known marked "balancer" chromosomes.

In order to identify the chromosome(s) responsible for the "altered ratio" effect, a number of stocks were synthesized carrying different combinations of chromosomes from the original *ey* and the Berlin stocks. After elimination of all "marked chromosomes" whose presence might affect the pterine concentrations, these stocks were analysed chromatographically. The results indicate that the "altered ratio" depends chiefly on the second and fourth chromosomes of the *ey* stock. Since the second chromosome does not produce any other phenotypic deviations from normal, its effect on pterine concentrations may be considered as "cryptic."

In view of the increasing utilization of the pterine patterns for the construction of taxonomic keys, it should be realized that cryptic genetic variability may give rise to striking intraspecific differences in the concentrations of these substances.

GOLOVINSKAYA, K. A. *See* PROKOFIEVA-BELGOVSKAYA, ALEXANDRA, *et al.*

GOODGAL, SOL H. Expression and Segregation in *Hemophilus influenzae* Transformations. *The Johns Hopkins University, School of Hygiene and Public Health, Baltimore, Maryland, U.S.A.*

When *Hemophilus* cells are exposed to DNA derived from a variant strain, a fraction of these cells are transformed to the variant, and this number is directly proportional to the amount of DNA taken up irreversibly by the cells. Furthermore, it has been shown that transformations follow a single hit process, presumably due to the interaction between a particular molecule of DNA and the host cell.

Once a cell has taken up a molecule of DNA, metabolic activity is required before the cell can express the factor inducing transformation. Chloramphenicol, an inhibitor of protein synthesis in concentrations of 20γ/ml., blocks the development of competence in cells but does not prevent the irreversible uptake of DNA by cells that had previously developed competence. It also prevents expression of a transforming factor in cells, but if the inhibitor is removed before the cells lose viability, there is no loss in number of transformed cells.

In agreement with Alexander and Leidy, and Shaeffer, we have also shown that cells which undergo transformation for streptomycin resistance develop interesting resistance to the antibiotic. Some level of resistance develops within 30 minutes after uptake of the DNA molecule. If these cells are plated in the absence of the selecting agent and the clone analysed, the original cell divides normally giving rise to streptomycin sensitive progeny as well as streptomycin resistant progeny. However, a pure streptomycin resistant clone does not occur for 90 minutes (three generations) after DNA uptake. Linked transformations for streptomycin and cathomycin exhibit similar behaviour with no evidence of segregation of the single characteristics in the 23 clones analysed. Clonal analysis of unlinked double transformations shows that about one-fourth of the clones give single segregants. Possible mechanisms for these results will be discussed.

GOODMAN, B. L. *See* JAAP, R. GEORGE.

GOWANS, CHARLES S. Genetic Investigations on *Chlamydomonas eugametos*. *Department of Botany, University of Missouri, Columbia, Mo., U.S.A.*

Genetic studies have been made with the unicellular green alga *Chlamydomonas eugametos*, starting with wild-type stocks originating from F. Moewus.

By a replication technique, following ultraviolet irradiation 39 nutritional mutants were obtained, including strains requiring special carbon-sources, nicotinamide, *para*-aminobenzoic acid, thiamine and purines. We also obtained 25 morphological and physiological mutants characterized by loss or paralysis of flagella, twinning, altered pigmentation, requirement for high osmotic pressure, and streptomycin resistance.

Studies on crossing-over have been done almost exclusively by means of tetrads. Some 3,000 segregants from over 800 zygotes have been characterized in crosses where from 1 to 5 genes were segregating. Equations for computing genecentromere distances have been applied, and eleven genecentromere distances have been computed. Normal linkage has not been detected, but cases of "negative linkage" (a significant excess of non-parental ditype tetrads) have been obtained. Tetratype frequencies in excess of two-thirds have been found. Preliminary studies on the relationship between temperature and crossing-over frequency indicate that it is not a simple linear one.

Hybrid zygotes from *C. eugametos* × *C. moewusii* (from R. A. Lewin) gave good germination, and the progeny showed recombination for five segregating genes, making doubtful the status of these two as separate species.

No evidence has been found to support Moewus' report that lower temperature inhibits crossing-over at the 4-strand stage, or that sex determination involves non-allelic genes. Moreover, tetratype segregations have been observed for unlinked genes, contrary to Moewus' published data.

GOWEN, JOHN W., and MAGNHILD UMAERUS. Biological Recovery from Radiation Effects as Related to Genetics. *Genetics Department, Iowa State College, Ames, Iowa, U.S.A.*

Radiation exposure, to many people, means irretrievable injury to health, vigor, life span, reproductive cells and future progenies. For genes, doubling the roentgen dose doubles the mutation rate; thereby increasing the dangers to subsequent generations. These conclusions seem incompatible with life having a continuum of irradiation with highly penetrating energy of chemical and outer space origins over millions of years.

When mice are irradiated there is an acute effect on life span followed by partial recovery. The authors have examined populations of *Drosophila* germ cells and find that recovery is expressed in several ways. Cells of the *Drosophila* germ tracts were exposed to multiples of 2,000 r given on 0 days after emergence and at 14, 28 and 42 days thereafter. Eight days immediately following the first irradiation the percentages of sex-linked lethal mutations were: no radiation, 0.0; 2,000 r, 3.6; 4,000 r, 10.3; 6,000 r, 13.5; and 8,000 r, 18.3. A 14-day interval between irradiation and the germ cell sample had reduced the initial lethal percentages to one-fifth, a 28-day interval to one-seventh, a 42-day interval to one-eleventh. The potential germ cell population has undergone biological improvement.

To allow time for repair irradiations were spaced: 2,000 r at 0 day; 2,000 r at 14; 2,000 r at 28; and 2,000 r at 42 days, giving an accumulated series of 2,000, 4,000, 6,000 and 8,000 roentgens to each male. Sperm from these periods showed mutation rates of 4.9, 5.2, 5.9 and 10.7% as contrasted with 3.6, 10.3, 13.5 and 18.3% where the corresponding irradiation dosages were received in single periods. The populations of repeatedly irradiated sperm recovered most of their normal characteristics before the following irradiation again raised the mutation percentages. Mutations in early germ cell lines appear to increase somewhat the observed lethals in the progenies of the 42-day males receiving high irradiation dosages. Data on visible mutations, survival of offspring in first and second generations bear on this problem and may be presented. Biological recovery has significance in clearing radiation damage from both the soma and populations of germ cells. (This work has received assistance from Contract No. AT(11-1)107 from the Atomic Energy Commission.)

GOWEN, JOHN W. *See* BRYAN, JOHN H. D.; FUNG, SUI-TONG, *et al.*; STADLER, JANICE.

GOWER, JOSEPHINE S. *See* RUSSELL, W. L.

GRAF, G. E. Paper Chromatographic Analysis of Heterozygotes in *Drosophila melanogaster. University of Zürich, Zürich, Switzerland.*

The fluorescent patterns, due primarily to pteridines, have been studied quantitatively in *Drosophila melanogaster* heterozygous for a number of genes generally regarded as recessive. Heads of three day old imagos were chromatographed as described by Hadorn and Mitchell and fluorescence measurements were made directly on the paper. Some eye colour mutants, though not all, caused readily reproducible, quantitative changes in the content of fluorescent substances, but no qualitative differences were found. These changes were caused in a number of different wild-type lines and remained essentially the same after the mutant had been backcrossed to the wild-type line for a number of generations. It was further found that organisms heterozygous for two mutants often showed patterns whose deviations from wild type were difficult to explain on the basis of the action of the individual mutants. (This study was aided by a post-doctoral fellowship grant of the American Cancer Society.)

GRAHN, DOUGLAS, KATHERINE F. HAMILTON, and GEORGE A. SACHER. Genetic Variation in Chronic Radiation Mortality and the Reduction of Life Expectancy among Inbred Mouse Strains following Single Dose Whole-Body X-Irradiation. *Argonne National Laboratory, Lemont, Ill., U.S.A.*

Inbred mouse strains BALB/c, A/Jax, A/He, $C3H_f$/He and C57BL/6 were exposed at an average age of 85 days to acutely lethal single doses of 200 kvp X-rays. $LD_{50}/_{30}$ values ranged from 500 r for strain BALB/c to 630 r for C57BL/6 (Grahn and Hamilton, Genetics *42*:189). Survivors of the acute syndrome were kept for an analysis of chronic radiation injury.

Significant differences in reduction of mean after expectation of life are observed between sexes and among strains within each sex. At a constant dose of 570 r, females show a 29.7 ± 1.0% reduction as compared to 22.0 ± 1.2% for males. Within sex, the reduction of life varies with strain from 22% to 41% for females, and from 16% to 30% for males. At their respective $LD_{50}/_{30}$ doses, the strains also express significant differences. This variation in the reduction of after-survival must be under genetic control, since it cannot be related to differences in either dosage or levels of acute injury.

Analysis of age specific mortality rates indicates that the life tables of most strains are similarly altered by single irradiations. The regression of log mortality rate on age is displaced to the left (or upward) of the control, but remains reasonably parallel to the latter, as noted in an earlier study (Sacher, Radiology *67*:250). Perturbations of this pattern are noted in strain C57BL/6, which has a high sensitivity to radiation leukemogenesis, and in strain BALB/c, which has a high infectious disease incidence.

An intriguing positive inter-strain relationship is detected between the magnitude of the acute LD $_{50/30}$ dose and the mean life expectancy of unirradiated mice. Small and variable sex differences in both parameters also tend to be directly proportional. While strain differences in reduction of life are not related to differences in either control survival or $LD_{50/30}$, the latter reflects the normal viability of the strain. (This work was performed under the auspices of the U. S. Atomic Energy Commission).

GRANT, WILLIAM F. Cytological Aspects of Sex Determination and Phylogenetic Trends in Dioecious Species of *Amaranthus*. *Department of Genetics, McGill University, Macdonald College P.O., Que., Canada.*

Cytological observations have been carried out on four dioecious species of *Amaranthus*, two of which were formerly included in the genus *Acnida*. The species studied are *A. arenicola, A. palmeri, A. tamariscinus* and *A. tuberculatus*. Three of these species have a diploid chromosome number of 32, while *A. palmeri* has a somatic chromosome number of 34. A single spontaneous triploid ($2n = 48$) female plant was found in collections of *A. tamariscinus* and a tetraploid ($2n = 64$) male plant in collections of *A. tuberculatus*. A fifth species, *A. australis*, has previously been reported as having 32 somatic chromosomes. The chromosome numbers for half the dioecious species of *Amaranthus* have now been determined.

Detailed observations on the dividing chromosomes of these species in mitosis, meiosis and in the first division of the nucleus in the pollen grain have been made and have failed to distinguish heteromorphic chromosomes which might be associated with sex determination.

It has not been possible to indicate phylogenetic trends based on the morphology of the chromosomes. The small size of the chromosomes has made detailed morphological studies impractical and there is no marked difference in absolute size of the chromosomes between species.

Since basic numbers of 16 and 17 are found in both monoecious (reported and unpublished observations) and dioecious species, it would seem that the aneuploid condition in *Amaranthus* arose early with subsequent divergent evolution.

GREB, RAYMOND. *See* MORGAN, WALTER C.

GREEN, G. J. *See* WELSH, J. N.

GREEN, M. M. On the Occurrence of Non-Homologous Pairing and Crossing-over in *Drosophila*. *Department of Genetics, University of California, Davis, Calif., U.S.A.*

The sporadic occurrence in *Drosophila* of tandem duplications exemplified by *Bar*, *Beadex-recessive* and the *Star* duplication can be accounted for by assuming that crossing-over occurs within paired, non-homologous segments of chromosomes. Presumably the products of these events should include deficiencies as well as duplications. Investigations of the crossing-over relations of the sex-linked, recessive white pseudo-alleles *apricot* (w^{a}) and *apricot-2* (w^{a2}) in *Drosophila melanogaster* uncovered genetic events which best fit an interpretation of non-homologous pairing and crossing-over occurring under genic control.

From homozygous w^{a} females made heterozygous for appropriate recessive marker genes to detect the occurrence of crossing-over as well as autosomal inversions *Curly* and *Ultrabithorax-130* two exceptional types have been recovered, each associated with a single crossover. Genetic evidence shows that one exception consists in a loss of either a portion of or the entire *white* region of the chromosome and a chromosome segment of undetermined length to the left of *white*. Supporting this conclusion, we find that the exceptional chromosomes produce male lethality, show pseudodominance when heterozygous for *w* mutants, cannot be covered by duplications known to cover the *white* segment but not extending beyond the left limits of *white* (e.g., *Dp* (1;3) w^{+5167}), and can be successfully covered by longer duplications covering *white* as well as gene loci to the left of the *white* (*Dp* (1;3) $w^{v,co}$). Analysis of the second exception demonstrates that it is a tandem duplication in which w^{a} together with a chromosome segment of undetermined length to its left is repeated. Phenotypically the w^{a} duplication is distinctly darker than w^{a}. From females heterozygous for the duplication and a wild-type chromosome, w^{a} has been recovered in association with unequal crossing-over.

Additional exceptions will be presented and the occurrence of the exceptional types will be discussed. It will be shown that these data furnish direct evidence that crossing-over is not invariably an event associated with allelic associations of homologous chromosomes.

GRELL, E. H. Genetics and Biochemistry of "red cell" in *Drosophila melanogaster*. *California Institute of Technology, Pasadena, Calif., U.S.A.*

The mutant phenotype of *Drosophila melanogaster*, "red cell," is characterized by the coloration of some of the free floating fat cells in the hemocoel with a reddish pigment related to the brown eye pigment (Jones and Lewis, 1957).

Genetic analysis reveals that a pair of complementary recessive genes produces the "red cell" phenotype. Both genes, *rc* (red cell) and *lys* (lysine), must be homozygous for the fat cells to be pigmented. Employing the markers Sternopleural, dachs and Jammed the following map of the five loci can be constructed from analysis of cross-over data: *Sp*–.9–*lys*–1.8–*d*–2.4–*rc*–4.5–*J*. If *Sp*'s standard map location of 22.0 is used, *lys* is 22.9 and *rc* is 27.1 map units from the left-most marker on the second chromosome.

No detectable phenotype is produced by *rc* without *lys*; but *lys* homozygotes, with or without *rc*, show an accumulation of the amino acid, lysine, when they are squashed on paper and chromatographed. Lysine is accumulated because *lys* probably blocks some step in its degradation. Eight hours after injection of C^{14} randomly labelled 1-lysine into Canton-S and *lys* adult males, 30% of the recovered radioactivity is found in the respired CO_2 of the wild-type, but only 3% is found in the respired CO_2 of *lys* flies. A dicarboxylic acid, which becomes more highly labelled after injection of labelled lysine into Canton-S than after injection into *lys* flies is believed to be an intermediate in the degradation of lysine and to be formed subsequent to the step at which *lys* blocks the degradation pathway.

GRELL, RHODA F. Preferential Segregation of the Sex Chromosomes in XYY Males of *Drosophila melanogaster. California Institute of Technology, Pasadena, Calif., U.S.A.*

Data of Bridges (1916) and Stern (1929) have usually been interpreted as meaning that the segregation of the sex chromosomes in an XYY male of *Drosophila melanogaster* is non-preferential. If such is the case, the ratio of XY/Y to X/YY segregations is expected to be 2:1. In the present experiment, males which carry two normal Y chromosomes derived from a Canton-S stock as well as a normal X chromosome were mated to females with a dominant brown-variegated (bw^{VDel}) phenotype. The brown variegation, in this case, is completely suppressed in the presence of an extra Y chromosome. The 2,822 brown-variegated progeny from these matings fall into the following classes, 1,153 XXY females, 307 XX females, 1,155 XY males and 207 XYY males. The ratio of XXY:XX female progeny based on these data is 3.75:1 indicating preferential segregation. The corresponding ratio for male progeny is 5.6 XY to 1 XYY. This somewhat higher ratio may indicate a lowered viability for XYY males. Bridges' data consisting of 39 XXY and 15 XX daughters of XYY males are in fact statistically compatible with a 3.75:1 ratio.

GRIFFITHS, D. J., D. G. ROWLANDS, and W. T. H. PEREGRINE. Cytogenetic Inter-relationships of Certain Artificial and Natural Polyploid Species of *Avena. Welsh Plant Breeding Station, University College of Wales, Aberystwyth, Wales.*

One of the primary purposes of synthesizing new amphidiploids in cereal crops is to study the possibilities of introducing genetic factors controlling valuable economic characters from related diploid and tetraploid species and genera to varieties of agricultural importance.

In *Avena*, various experimental 6x amphidiploids have been produced through crossing tetraploid and diploid species followed by colchicine treatment of the resultant triploid hybrids. Representative plants from the A_2 and A_3 generations of the 6x amphidiploid developed from *A. barbata* × *A. strigosa* sub. sp. *hirtula* were crossed with the natural hexaploid species as well as with other amphidiploids and the data obtained on meiotic behaviour, seed fertility, and morphological characteristics of the F_1 hybrids are presented and discussed.

Hybrids derived from crosses between the amphidiploids and the natural species and those derived from amphidiploid × amphidiploid crosses revealed differences in chromosome pairing, seed fertility and in the dominance relationships of the mode of spikelet disarticulation, floret disjunction and degree of awning.

All hybrids between the amphidiploids and the natural hexaploids proved to be almost completely self-sterile whereas those obtained from crosses involving different amphidiploids gave seed sets comparable with their parents. Bivalent formation in the former group of crosses was markedly lower than in the amphidiploid parent, the mean values being 7.8 bivalents compared with 14.34, and in the latter crosses was similar to that observed in parental plants, but with rather fewer univalents.

In contrast with the 6x amphidiploid × *A. sativa* hybrids in which separation of the spikelet from the peduncle by fracture was partially dominant over the shedding base, hybrids derived from the 6x amphidiploid and other amphidiploids with cultivated base type spikelets exhibited a complete reversal of the dominance relationships, the shedding base type being dominant over the normal base as found in the diploids and tetraploids.

GROSCH, DANIEL S. Somatic Cytology of the Wasp *Habrobracon. Department of Genetics, North Carolina State College, Raleigh, N.C., U.S.A.*

Multinuclear structural units are typical of the internal tissues of *Habrobracon* larvae. The multinucleate condition is attained by amitotic divisions resembling those of the macronucleus of ciliates. The nuclei of multinucleate units become highly polyploid during development. Tissues so comprised do not persist through metamorphosis. Adult tissues typically show uninucleate cells although certain nuclei enlarge greatly and are highly polyploid in the functional state. Trophocytes are good examples of such cells. Members of a group of these cells are structurally and functionally interrelated. Structural relations are seen as protoplasmic bridges. Functional relations are revealed by the staining reaction after the wasp has been exposed to radiation or a chemical agent. All members of the group react similarly. Thus, in both larvae and adults, the structural mechanism of secretory and elaborative physiological activity is more complex than merely a unit composed of a circumscribed mass of protoplasm containing a single nucleus.

GRUN, PAUL. Cytological Instability of Accessory Chromosomes from Native Populations of *Allium cernuum. Department of Botany and Plant Pathology, Pennsylvania State University, University Park, Pa., U.S.A.*

Telocentric fragment-sized euchromatic accessory chromosomes have become established in native populations of nodding onion, *Allium cernuum*, over an extensive area. Variant types, including larger accessories and an isochromosome form, are more locally restricted. Proportion of plants of fourteen separate populations from Pennsylvania and West Virginia containing accessories varies through a continuous series from 0% to 50%. There is no apparent relationship between geographical distribution or the local ecological situation and frequency of accessories in a population.

Telocentric accessories are highly unstable in mitotic divisions as reflected in variability of number in different cells within and between root tips and in different microsporocytes of each plant. By contrast, the isochromosome is mitotically stable. Analysis of second anaphase figures of meiosis shows that telocentric accessories are distributed as follows: they do not pair with one another or with the normal chromosomes, but drift to poles at random during first anaphase, few being lost to micronuclei; during the second anaphase they divide normally.

Allium cernuum accessories differ from those previously described in no single character, but in the alignment of previously described types of variability. The cytogenetic resemblances and differences among known types of accessories will be discussed in relation to their evolutionary significance.

GURGEL, J. T. A. The Non-Homologous Associations of Centromeres and Knobs of Maize Chromosomes at Meiosis. *Escola Superior de Agricultura "Luiz de Queiroz," São Paulo, Brazil.*

In the present work the author deals with the non-homologous association of centromeres and knobs in maize, the two exceptions to two-by-two pairing of chromosomes at pachynema. This research was carried out in the inbred KYS and in 5 homozygous reciprocal translocations. It was shown that the number of centromere adhesions is a function of relative length for all the chromosomes with exception of chromosome 5, which is more frequently involved than expected. Also, it was found that in spite of not being significant for each case studied, chromosomes 1, 2, 6 and 10 are encountered less often in centromeric adhesions, and chromosomes 4, 7 and 8 oftener than one would expect. In considering knob adhesions, the frequencies found deviate largely from expectation. For both centromere and knob adhesions, it was found that the presence of the nucleolus attached to chromosome 6 tends to reduce the associations of this particular chromosome in pairs. The data found in this research for centromere, knob and terminal ends associations do not support the hypothesis that heterochromatin is responsible for these associations.

GYÖRFFY, B., and I. KÁLLAY. Discrimination between Genotypic and Phenotypic Variation of Streptomycin-Resistance in *Serratia marcescens. Institute of Genetics, Budapest, Hungary.*

Despite considerable experimental evidence that drug-resistance has a genetic origin, there is still some controversy concerning its development in bacterial populations. By the information-decoding receptor model we can distinguish between the origin of resistance as a potency of the genotype and its development as a secondary process expressed in the phenotype. Ignorance of this distinction resulted in a widespread confusion of the shift at the tail of phenotypic variation with genuine genetic changes. We designed our experiments to decide the issue by critically discriminating technique and to resolve the response of the individuals, not just the change in the population as a whole.

The indirect evidences we obtained for the genotypic variation in streptomycin-resistance are: discontinuous increase in serial transfers with small inocula, stable variants with low level of resistance, statistical demonstration of preformed clones and a good approximation to the statistical prediction of the expected distribution, and mutation rates similar to those observed in other bacteria. The range of the phenotypic expression of a genotype is broader than is assumed. Culturing or "training" performed in complex medium impressed changes leading to a shift in the limits of the phenotypic variation without altering the genotype, thus simulating a continuous increase in resistance. But the complex medium also increases the proportion of true resistants by favoring the phenotypic expression of newly mutated cells arising in the culture. By re-tests in differential medium the limits of the phenotypic variation could be satisfactorily narrowed and the disturbing occurrence of overlap between physiological and genetic variation eliminated. This could also be proved in artificial reconstruction experiment with sensitive and phenotypically expressed resistant cells.

HAAS, FELIX L., and C. O. DOUDNEY. Relations between Nucleic Acid and Protein Syntheses in Ultraviolet-Induced Mutation in Bacteria. *University of Texas M. D. Anderson Hospital and Tumor Institute, Houston, Texas, U.S.A.*

A hypothesis has been advanced that nucleic acid precursors altered *in vivo* by ultraviolet (*UV*) constitute chemical intermediates in mutation (Haas and Doudney, Proc. Nat. Acad. Sci. *43*: 871–883). Increased UV-induced mutations in *Escherichia coli* strain B ("EMB-color" mutations) and in *E. coli* wp2 (reversion of tryptophan requirement) by pre-irradiation incubation in basal medium supplemented with RNA ribosides or purines and pyrimidines have led to this conclusion. Witkin's studies (Cold Spring Harbor Symposia Quant. Biol. *21*: 123–140) and ours indicate that mutation induction is related to post-irradiation supply of amino acid. Our studies also indicate that UV-induced mutation may depend on *post-irradiation* synthesis of nucleic acid from radiation-modified precursors, and probably involves concurrent protein synthesis.

Further studies (Doudney and Haas, Proc. Nat. Acad. Sci., in press, 1958) have shown that the amino acids are required for a process of post-irradiation "mutation stabilization." When irradiated cells are held under certain conditions limiting to amino acid or protein synthesis, there is immediate decline in induced mutation frequency. If amino acids are present, the mutations are subsequently "fixed" into the genetic composition of the cell.

The following has now been established regarding post-irradiation "mutation stabilization" and "mutation frequency decline": "mutation stabilization" requires a complex source of amino acids, and an energy source. Omission of one of these factors results in "mutation frequency decline." Deletion of phosphate from the medium, or dinitrophenol inhibition, prevents "mutation stabilization," but does not lead to "mutation frequency decline." By using 5-hydroxyuridine (an analogue blocking orotic acid conversion to uridine, thus preventing RNA synthesis) in the post-irradiation incubation medium it has been found that processes leading to RNA synthesis are involved in "mutation stabilization." The results suggest a possible intermediary role of RNA and protein synthesis in genetic DNA replication.

HABERLANDT, WALTER F. Genetic Aspects of Amyotrophic Lateral Sclerosis and Progressive Bulbar Paralysis. *Institut für Humangenetik der Universität Münster, Münster/Westf., Germany.*

Owing to the initiative of Prof. v. Verschuer, Director of the Institute of Human Genetics, University of Münster, and with the aid of a large staff of co-workers, a thorough registration of pathological traits and clinical syndromes (considered to be caused by mutant genes) is being carried out, in a population of about 2 million people, to supply data for statistical studies.

Two conditions investigated for the last two years are amyotrophic lateral sclerosis and progressive bulbar paralysis. A systematic search in neurologic departments and mental hospitals of Westfalia revealed 251 index cases in a population of about 250,000 neuro-psychiatric patients observed during the last 30 years.

Our investigation is a family study (including a small twin series only). All living probands are given clinical examination and anthropological tests; catamnestic data are obtained from relatives of deceased index cases. The clinical results of our research are in good agreement with those reported by other authors.

The genetic analysis of our material may help to clear up inconsistent concepts based on earlier data. Of the cases re-examined so far 13.5% are hereditary. In our pedigrees an autosomal dominant gene with incomplete penetrance and varying expressivity can be demonstrated. Apart from this genetic basis for the manifestation of amyotrophies, environmental influences must be taken into consideration. The etiology of Charcot's disease could be explained by both constitutional and peristatic factors. Its pathogenetic mechanism is still unknown; it may be some metabolic defect. As for the sporadic cases (which comprise the great majority in all samples so far published), the role of mutations is discussed. Mutation rates of Charcot's disease have not yet been calculated.

HAGA, TUTOMU, and SHOZO NODA. Cytogenetic Population Structure of *Scilla scilloides* Druce: A Complex. *Cytogenetics Laboratory, Department of Biology, Kyushu University, Fukuoka, Japan.*

Karyotypes of the two basic complements A(x=8) and B(x=9) are clearly distinguishable in diploids and in polyploids of *Scilla scilloides* Druce. At meiosis, types of the constitution AA form 8_{II}, BB 9_{II}, BBB 9_{III}, ABB $9_{II}+8_{I}$, and AABB 17_{II}. Therefore, the two basic complements are genetically well differentiated from one another. Pairing $2_{III}+7_{II}+6_{I}$, observed in 1% of the PMCs in ABB, suggests a remote homological relationship between the two distinct basic complements.

The types of chromosome constitutions found in natural populations in the vicinity of Fukuoka, Japan, were as follows: BB, BBB, ABB, AABB, ABBB $(9_{III}+8_{I})$ and AABBB$(9_{III}+8_{II})$. Each of the types is further classifiable into several subtypes with respect to the supernumerary chromosomes, structural rearrangement, for instance BB(9_{II}) and $BB^{T}(.4+7_{II})$ in the type BB. The type AA is known only from South Korea.

Natural population at a given locality consists of the types with constitutions related to one another: for example, BB(8), BB^{T}(30), and BBB(12) at Mitusawa; BB(16), BBB(21), ABB(39), AABB(14), and ABBB(34) at Nakabaru. Figures given in parentheses indicate the number of plants examined cytologically. Thus, it is clear that the compositions of the natural populations of this complex have been much complicated by hybridization and also by vegetative propagation of the sexually unstable or sterile types.

HAGEMANN, RUDOLF. Somatic Gene Conversion in the Tomato. *Institute for Research of Cultivated Plants, Gatersleben Kreis Aschersleben, Germany.*

A series of multiple alleles of a locus named sulfurea has been found. The homozygotes of sulfurea^{pura} alleles (*sulf*^{pura1}, *sulf*^{pura2}, etc.) have yellow cotyledons. They die within a fortnight if not grafted on control stocks. The grafted *sulf*^{pura} plants form pure yellow leaves. The homozygotes of *sulfurea*^{variegata} (*sulf*^{vag}) are semi-lethal. The leaves of all grafted sulf^{vag} plants are green-white variegated. This variegation is largely due to modifications. Grafted *sulf*^{pura} and *sulf*^{vag} homozygotes are fertile. The heterozygous *sulf*$^{+}$*sulf* plants (*sulf* means *sulf*^{pura} or sulf^{vag}) have green cotyledons like those of normal *sulf*$^{+}$*sulf*$^{+}$ plants. In further development part of the heterozygotes shows a green-white variegation of foliage leaves. The *sulf* alleles isolated till now differ by the percentage of variegation they cause in heterozygous plants. Progenies of both green and variegated branches have been analysed. The variegation of the foliage leaves is caused by mutation of the normal allele *sulf*$^{+}$ to a recessive *sulf* allele. The white regions are of *sulf sulf* constitution. The *sulf*$^{+}$ allele is stable in homozygous pants. In heterozygous condition, however, mutations of *sulf*$^{+}$ to *sulf* occur under the influence of the *sulf* allele already present. Such a directed mutation, which has been termed "conversion" by H. Winkler (1930), occurs in somatic tissues of the shoot extending to generative tissues if the mutated areas take part in the formation of reproductive organs. Thus deviations from normal 3:1 segregation appear resulting in an increase of *sulf sulf* seedlings. In the present case, consequently, somatic conversion is concerned. Problems of conversion in sulfurea as well as relations between somatic and meiotic conversion will be discussed.

HAIR, J. B. The Chromosomes of the Podocarpaceae. *Botany Division, Department of Scientific & Industrial Research, Christchurch, New Zealand.*

The chromosomes of representative species of the 7 genera of the Podocarpaceae are analysed and compared. All genera are diploid, with basic numbers as follows: *Phyllocladus*, 9; *Acmopyle*, 10; *Saxegothaea*, 12; *Pherosphaera*, 13; *Microcachrys*, 15; *Dacrydium*, 9–12, 15; *Podocarpus*, 10–13, (16), 17–19. Cytological evidence suggests that with certain exceptions these numbers fit an evolutionary series in which repetitive "centric fusions" reduce a primitive basic set of 20 acrocentric chromosomes ($2n = 40$) to a "saturated" level of 10 metacentrics only ($2n = 20$). At any point in this series the number of metacentric pairs in homozygotes corresponds to the number of fusions which have taken place. Of the 11 chromosome numbers expected in this scheme 8 (potentially 9) have so far been found, including 7 in *Podocarpus* alone.

The system proposed rests on the following observations: (1) close morphological correspondence between the idiograms of related species of adjacent basic numbers; (2) chromosome pairing in natural hybrids—the hybrid between *P. nivalis* ($x = 19$) and *P. hallii* ($x = 17$) invariably shows two trivalent associations at meiosis; (3) the preservation of the intermediate evolutionary steps, *intra-specifically*, in several species of two closely allied sections of *Podocarpus* where the number of chromosomes ranges from $2n = 38$–33 (of the 8 species examined so far, 6 contain presumed fusion heterozygotes, to the number of 14 in a total of 21 immature plants); (4) the comparison between the equivalent chromosome arms of homozygotes and heterozygotes of lower chromosome number respectively, which favours the concept of a *descending* basic series.

At present it would be unwise to insist upon the one-way scheme proposed; nevertheless such a sequence would represent continuous progress toward an economy of centromeres and stability of chromosomes.

The present instance of chromosomal polymorphism, which embraces not only the homozygous (or partly "saturated") but also the heterozygous (or transitional) phases of the evolutionary succession, appears to be the most striking example as yet described in the plant kingdom and is a surprising discovery amongst long-lived woody plants generally.

These findings are briefly discussed in relation to taxonomic questions.

HAMERTON, JOHN L., and CHARLES E. FORD. Chromosome Polymorphism in Wild Populations of the Common Shrew, *Sorex araneus. M.R.C., Radiobiological Research Unit, Atomic Energy Research Establishment, Harwell, Didcot, Berks., and British Museum (Natural History), South Kensington, London, England.*

Sorex araneus is a successful and widely distributed palearctic insectivore. It has recently been established that the species has 2 unusual features of cytogenetic interest: (*a*) males have 3 sex chromosomes (XY_1Y_2) whereas the females have the normal 2 (XX); (*b*) numerical chromosomal polymorphism of the Robertsonian (fragmentation-fusion) type occurs. The latter is complex: 6 medium sized autosomal elements (3 pairs) may occur in alternative metacentric or twin acrocentric states. The actual diploid number therefore varies from 21 to 27 in different males and from 20 to 26 in different females. Of the 27 theoretically possible autosomal combinations 22 have been identified.

Most of the animals examined were obtained from 3 localities within the county of Berkshire. The results show that significant differences in the frequencies of the alternative chromosomal states may occur from year to year in the same locality, and from locality to locality in the same year.

In 1957 small samples were obtained from 3 other more widely separated localities in Britain. Surprisingly all but one of the 19 animals were complete structural homozygotes. However, there was a different type at each locality. In all, 8 different structurally homozygous types are possible.

The case is presumably an example of balanced rather than transient polymorphism, but the evidence gathered so far does not demonstrate this decisively. It does, however, suggest that shrew populations are commonly small and relatively isolated from one another. It will be the main task of the 1958 collecting season to obtain samples from still further localities to determine (*a*) under what conditions mixed populations occur, and (*b*) whether the distribution about the country of the homozygous populations is orderly or random. It is hoped to present preliminary results from studies to the Congress.

HAMILTON, KATHERINE F. *See* GRAHN, DOUGLAS.

HANNA, BERTRAM L. Measures of Group Divergence for Two and Three Allelic Systems. *Medical College of Virginia, Richmond, Va., U.S.A.*

The comparison of allelic frequencies in two groups of individuals may be accomplished using simple chi square tests if the frequencies of each independent locus are considered separately. In estimating the genetic relationship among groups it is often desirable to combine information about the frequencies at numerous loci to obtain a single measure of group divergence. Hiernaux (Ann. Musée Royal du Congo Belge, 1956) has employed the summation of χ^2 values at different loci as a measure of divergence between human populations. This statistic is appropriate for use with loci having two alleles since $\Sigma\chi^2_{(1)}$ approximates the square of linear distance measured as unit normal deviates $(\chi_\phi{}^2_{(1)} \simeq k_{\phi/2}{}^2)$. The variance of a $\Sigma\chi^2_{(1)}$ value estimated from r loci is given by

$$V = \sum_{i=1}^{r} \frac{p_i(2n_i - 6) + 1}{n_i p_i}$$

where n_i and p_i are respectively the number and the frequency of an allele at the ith locus. The significance of the divergence measured by an observed $\Sigma\chi^2_{(1)}$ is tested by determining its deviation from the value r expected under the null hypothesis. The inclusion of χ^2 values derived from loci having three alleles will invalidate this measure since $\chi_\phi{}^2_{(2)}$ approximates $-2 \log_e\phi$. $\chi^2_{(2)}$ values may, however, be transformed to normal deviates and summed together with those derived from two allelic systems. The significance of the divergence measured by this combined value may not be determined.

Values obtained with these measures of two and three allelic systems and those obtained by combining values are compared with the measures obtained by Hiernaux and by other workers.

HARLAN, JACK R. *Bothriochloa intermedia* A. Camus: A Study in Speciation.

Department of Agronomy, Oklahoma State University, Stillwater, Oklahoma, U.S.A.

Forty-one accessions of *Bothriochloa intermedia* were studied critically for evidences of introgressive hybridization. On the basis of morphological variation patterns, it was concluded that sixteen of the lots had been derived from *B. intermedia* × *Dichanthium annulatum* hybridizations; four of the accessions showed evidence of being *B. intermedia* × *B. ischaemum* derivatives; four lots showed strong evidence for introgression with *B. pertusa*; three lots apparently had characters derived from *Capillipedium parviflorum*, and the residual fourteen accessions of *B. intermedia* constituted a hodge-podge of material of diverse origin which, for the moment, defies analysis. Some experimental evidence is available to support these conclusions. The assumed *B. intermedia* × *Dichanthium annulatum* derivatives have been called the gangetica type of *B. intermedia.* All accessions of the gangetica type so far tested are facultative apomicts and hybrids have been made artificially between gangetica forms and several types of *B. ischaemum, B. intermedia, B. pertusa, Dichanthium annulatum* and *Capillipedium parviflorum.* One accession of *B. intermedia* × *B. ischaemum* was also tested and found to be partly sexual. Accessions of *B. ischaemum, Capillipedium parviflorum,* and *B. pertusa* so far tested have all been highly apomictic as well as most lots of *B. intermedia* other than gangetica types. Other species such as *B. ewartiana* have probably also contributed germ plasm to this remarkable synthetic taxon. *Bothriochloa intermedia* appears to be a repository for germ plasm from at least five species belonging to three genera.

Harrington, James B. FAO Regional Plant Breeding Projects. *Food and Agriculture Organization of the U.N. Rome, Italy.*

During the past eleven years the Food and Agriculture Organization has been conducting three regional projects in plant breeding: the Rice Improvement Project under the International Rice Commission; the Hybrid Maize Project in Europe and the Mediterranean region; and the Wheat and Barley Breeding Project in the Near East. These projects, through regional meetings of technical personnel, regional training centres, the services of regional consultants, the awarding of fellowships, and the exchange and cooperative testing of breeding material, have contributed to a notable increase in (1) the number of well-trained technical personnel, (2) the number of cereal breeding laboratories, greenhouses, nurseries and field tests, (3) the understanding of the economic value of plant breeding research and its dependence on genetics and statistics, and (4) the development of superior new varieties.

The Maize Project (11 years old) has promoted the replacement of ordinary maize by hybrid maize and the adoption of the specialized procedures for breeding, producing and utilizing hybrid maize. The project has already resulted in increased maize production estimated at $68,000,000 annually. The Rice Project (8 years old) has promoted genetic and physiologic studies and featured extensive crossing of *indicas* with *japonicas* in connection with breeding for high response to chemical fertilizers. A number of newly developed rice varieties are ready for distribution. The Wheat and Barley Project (6 years old) has aroused new interest in the improvement of these ancient crops. Special features are the cooperative nurseries of rust and smut resistant genetic stocks from all parts of the world and the regional rust race survey. Promising new varieties have been developed and are being tested.

The cooperation of the countries participating in these regional projects is excellent. The three projects illustrate how a United Nations' technical agency can help on a regional basis to increase food production where it is most needed.

Harris, H., and E. B. Robson. The Genetics of Hypophosphatasia: The Excretion of Ethanolamine Phosphate in Clinically Normal Relatives. *London Hospital Medical College, Galton Laboratory, University College, London, England.*

Hypophosphatasia is a rare osteodystrophic disorder. One of its most striking biochemical features is a greatly increased excretion of ethanolamine phosphate in the urine.

The families of 14 individuals presenting with this condition have been investigated. No instance of parental consanguinity was observed. Out of 13 sibs of the propositi 2 were diagnosed as having hypophosphatasia. No cases of the disease were found among other close relatives. Urine specimens from 360 members of the families and from 100 normal controls were examined by paper chromatography following electrolytic desalting. The quantity of urine used in each case was standardised against the creatinine content of the urine. The only abnormality noticed was a slight but definitely increased excretion of ethanolamine phosphate in the urine of some of the relatives. It is suggested that the clinically affected individuals are homozygous for a rare gene which in heterozygotes leads only to a minor biochemical abnormality. The frequency of individuals in the different relationships who show this increased excretion of ethanolamine phosphate is consistent with the hypothesis that such individuals are heterozygotes, but that only 60% of presumed heterozygotes can be detected by the chromatographic methods used. Neither sex nor age appears to affect the excretion of ethanolamine phosphate.

The severity of the disease and the age at which the osteo-dystrophy becomes apparent are very variable. In the present material and in published cases sibs resemble each other rather closely in these respects. This suggests that more than one gene may be involved. Further heterogeneity is revealed by the fact that different sibships have different rates at which the presumed heterozygotes are manifest. Taking those sibships which contain the parent of a clinically affected case and classified according to the level of ethanolamine phosphate excretion in that individual, then among 51 sibs of parents whose heterozygous nature is manifest, 18 also excreted ethanolamine phosphate, but amongst the 25 sibs of parents who were not manifest heterozygotes only one excreted ethanolamine phosphate.

HARRISON, G. AINSWORTH. High Temperature Responses of Inbred and Hybrid Mice. *University of Liverpool, Liverpool, England.*

Harrison (J. Physiol. *138*: 54–55) has demonstrated that both the morphological and physiological changes that occur when mice are reared at high temperatures facilitate survival at a high lethal temperature. The comparative adaptability of inbred and F_1 hybrid mice to high temperatures has, therefore, been investigated. Animals were reared from three to eight weeks of age at either 70° F.D.B. 61° F.W.B. (control reared) or 90° F.D.B. 85° E.W.B. (heat reared) using a split litter experimental design and then exposed to 107° F.D.B. 85° F.W.B. It has been shown that (1) both control and heat reared C57BL x RIII hybrids survive longer than correspondingly treated C578L and RIII inbreds but less well than A inbreds; (2) the difference in the survival time of the control and heat reared hybrids is significantly greater than the difference between control and heat reared RIIIs. But the capacity of the C57s and As to acclimatize to the heat is the same as that of the hybrids.

Although there is evidence from an analysis of growth rates and variances of body weight that the magnitude of the response of the As is accentuated by their inability to adapt to the control conditions as well as they adapt to the heat, by every criterion studied the C57s appear to be as developmentally flexible as the hybrids.

The results therefore support the hypothesis that it is not heterozygosity as such which determines fitness but the greater likelihood of obtaining, in a naturally outbreeding organism, an adaptive genotype in heterozygotes than in homozygotes.

(This work was mainly undertaken in the Department of Anatomy, University of Oxford.)

HARTE, CORNELIA. Physiological Genetics of Leaf Development. *Institut für Entwicklungsphysiologie, Köln, Germany.*

The connections between genetic structure and physiological reactions are very well known, whereas the phenogenetics of morphological characters of higher plants are not often the object of research. We, therefore, took mutants which change the leaf form of *Antirrhinum, Oenothera* and various trees, and tried, by comparing them with the normal forms, to discover when and how the different genes act in the development of the leaves. We examined the morphological differentiation of the young leaves in the bud, and the histologic structure of leaves in different stages of development on microtome slides. Furthermore, we took measurements of growing leaves and of different characters of the full-grown leaves (length, width, and size of cells in different tissues, hairs and stomata in the epidermis). Examination of several mutants of different plants revealed the common trends of gene action. The development of the leaves comprises several distinct steps. In going from one step to the next, new meristems are formed and in the small-leaf mutants the beginning of the growth in a new direction is delayed. The development then proceeds too long in the one direction. The growth of the meristems is terminated by the onset of differentiation in the cells without regard to the actual growth of the leaf. In consequence the leaves of most mutants have some similarity to the forms exhibited by normal leaves in different stages of their development. Not only is the form of the leaves influenced, but also the size of the cells and the differentiation of some tissues. We cannot say that any of these genes act on different steps of leaf formation. In every leaf there are correlations between different steps of development, and we find regulating mechanisms when the development is disturbed genetically. We find what is called "relational-pleiotropy" by Hadorn.

HARTMAN, P. E., Z. HARTMAN, D. SERMAN, and J. C. LOPER. Genetic Complementarity in Histidineless *Salmonella typhimurium. Department of Biology, The Johns Hopkins University, Baltimore, Maryland, U.S.A.*

Linkage tests by complete transduction place the sites of mutation of over 140 independently isolated histidineless derivatives of *Salmonella typhimurium* within a small chromosome region. About 80% of the sites are separable by recombination. Of the 10% mutants not giving recombinants in reciprocal crosses, most may be differentiated from their partners by a characteristic level of negative interference, specific for each mutant. In approximately 10% of the mutations each mutation occupies many mutational sites, most frequently covering one or several *complete* loci. Most multisite mutants are exceptionally stable, but a few revert to prototrophy with high frequency.

The linearly arranged mutational sites have been divided into eight groups (loci H-E-F-A-B-C-G-D) on the basis of genetic mapping by complete transduction, biochemical criteria, and over 6,500 abortive transduction combinations for genetic complementarity. The loci are restricted to sharply defined and non-overlapping sub-sections of the histidine region; some appear polarized, leaky mutations occurring terminally. Six loci are primarily concerned with specific, individual enzyme reactions in L-histidine synthesis; the gene order reflects the order of the biochemical steps. The H and E loci may have more complex functions in enzyme control.

*Inter*locus tests show that genetic complementarity is generally demonstrable but is heterogeneously expressed, depending upon certain very specific mutant combinations. Particular mutations may secondarily affect reactions controlled by certain nearby loci; the presence of isoalleles is not excluded in other cases. In *intra*locus tests, negative responses have always obtained among mutants, respectively, of loci

H, E, F, A, C and G. Aberrant *intra*locus complementarity occurs with high frequency in locus B (imidazoleglycerol dehydrase), indicating four subunits. Rare exceptional positives have been noted in locus D (L-histidinol dehydrogenase), especially in combinations involving *hi-10* and *-208,* located at opposite ends of the locus.

HARTMAN, Z. *See* HARTMAN, P. E.

HARVALD, BENT, and MOGENS HAUGE. A Catamnestic Investigation of Danish Twins. *University Institute for Human Genetics, Copenhagen, Denmark.*

It is the purpose of our study to elucidate the role played by heredity in the aetiology of various diseases through a catamnestic investigation of an unselected twin series, comprising all twins born in Denmark in the years 1870–1910. Until now the data of more than 11,000 pairs have been procured. However, in only about 3,500 of these pairs have both twins reached the age of 5 years, and only these pairs have been included in the present study. For all these pairs information has been procured of disabilities of all sorts. In all cases of hospitalization, the case records have been studied, and all death certificates, autopsy records, histological examinations, etc., have been scrutinized. In this way it has been possible in most cases to establish a reliable diagnosis.

For most diseases manifesting themselves at older ages the importance of hereditary factors seems to be rather small. Therefore, nearly the same rate of concordance was found in monozygous and dizygous twin pairs for different forms of malignant growth and for different forms of arteriosclerotic disease. On the other hand a significantly higher concordance in monozygous than in dizygous twin pairs was found in bronchial asthma, diabetes, gall stones, toxic diffuse goitre and atoxic goitre, migraine, schizophrenia, manic-depressive insanity and mental deficiency.

Special attention has been paid to several other questions such as longevity, fertility, frequency of twin births in the families of twins, criminality and others, but the results are not yet available for discussion.

HASIMOTO, HARUO. Deviation of Sex Ratio Caused by Temperature Treatment of Silkworm Eggs Immediately after Deposition. *Matsumoto Branch, Sericultural Experiment Station, M.A.F., Matsumoto, Japan.*

In the silkworm the maturation division of the egg nucleus and fertilization occur immediately after the deposition. The author successfully induced dispermic androgenesis in the silkworm in 1934.

In the experiment described here eggs were transferred immediately after being laid by mated female from room temperature to a refrigerator at 2.5°C, and after 10 days of cold storage were subjected to a temperature at 40–41°C for 60 minutes. The materials used in the present study were the eggs laid by *yellow-bloody, sex-limited zebra* females mated with *lemon* or *sex-linked translucent* males. In both matings the progeny were exclusively male. Almost all the males showed the recessive character of the male parent. This is due to androgenesis. In addition, it is highly probable that the sperm nuclei in the egg can resist the cold, while the egg nucleus is not capable of surviving the same treatment.

In the experiment three lots of eggs were transferred immediately after deposition to a refrigerator at 2.5°C, O°C, and —2.5°C, respectively. After 43 hours of cold storage they were subjected to 39°C for 60 minutes. The sex ratio in the 0°C and —2.5°C lots showed a remarkable excess in the number of females, while in the 2.5°C lot it was nearly 100:100. The following generation was tested with the result that the majority of the females in the lots which showed an abnormal sex ratio were triploid or tetraploid, while those in the lot in which the sex ratio was normal were diploid. It seems clear that the cold treatment caused polyploidy in the female pronucleus.

Therefore, a difference in the temperature treatment of eggs induces a wide range of deviation in the sex ratio of the resulting silkworms.

HATTERSLY-SMITH, M. *See* ARMSTRONG, J. M.

HAUGE, MOGENS. *See* HARVALD, BENT.

HAYASHI, NORIO. *See* FURUHATA, TANEMOTO.

HEBB, CAROLINE RAUT, and THOMAS P. SINGER. The Adaptive Formation of Succinic Dehydrogenase during Aeration of Anaerobically Grown Yeast. *Detroit Institute of Cancer Research and Wayne State University College of Medicine, Detroit, Mich., U.S.A.*

The adaptive synthesis of succinic dehydrogenase induced by oxygen has been studied in normal yeast in an attempt to learn more as to the nature of such gene-controlled enzymes which require an external inducer for their production. Red Star yeast was grown anaerobically and then aerated in buffer and glucose to induce the formation of various oxidative enzymes in the absence of growth. At intervals during the oxygen adaptation, samples of yeast were broken in a Nossal shaker, and the subcellular particles sedimenting at 81,000 x g in 15 minutes were assayed for succinic dehydrogenase activity (1) using phenazine methosulfate as electron acceptor to assay the maximum activity of the primary dehydrogenase and (2) using cytochrome-c as acceptor to measure the succinate-cytochrome-c interaction which involves participation of an electron transport chain between the succinate and cytochrome-c. In a typical experiment, the activity of the primary dehydrogenase increased some 5-fold from 0.046 μM succinate/min./mg. protein at 30°C (15% of the activity of aerobic yeast) at the beginning of aeration to 0.25 μM succinate/min./mg. protein (85% of aerobic activity) after 23 hours aeration. At the same time the activity of the entire complex increased as much as 90-fold, starting from an extremely low activity of 0.0013μM succinate/min./mg. protein or less (around 1% of the aerobic activity).

A reduction of succinic dehydrogenase activity in anaerobically grown yeast of 96%–97% of that of aerobic yeast has been reported (Slonimski, La Formation des enzymes chez la levure, Paris, 1953, pp. 135–136) when measured using methylene blue or cytochrome-c as electron acceptors. However, comparison of the assay using cytochrome-c with that using phenazine shows that while succinic dehydrogenase in anaerobic yeast is decreased several fold compared with that in aerobic yeast, the components of the electron transport chain between the primary dehydrogenase and cytochrome-c as well as the oxidations involving these are essentially absent. Therefore the mechanism of enzymatic adaptation consists primarily of the formation of the electron transport chain.

HECHT, ADOLPH. Partial Restoration of Fertility in a Sterile *Oenothera* Mutant following Infection by a Parasitic Moth Larva. *State College of Washington, Pullman, Wash., U.S.A.*

A mutant of *Oenothera parodiana* was first observed in cultures of this South American species grown in Chicago in 1946. Mutant plants are characterized by a monstrous type of floral development, such that four bracts are formed at the juncture of the hypanthium with the ovary; the hypanthium is much reduced in length and the floral organs within the calyx are distorted in shape and develop only incompletely. No pollen is formed and the bud ordinarily fails to open, often prematurely aborting and drying. The meiotic configuration of the non-mutant plants is a circle of ten chromosomes and two pairs. Progeny obtained by selfing any of them gives rise to some plants with monstrous flowers. Over a seven-year period 773 of 3,506 plants, or 22%, were phenotypically mutant. It appears that the normal plants must all be heterozygous, and that certain expected classes of progeny die at some stage prior to seed germination. Support for this interpretation comes from one instance of obtaining approximately 50% plants with monstrous flowers by a successful pollination of a monstrous-flowered plant, and from two instances of 100% plants with monstrous flowers following X-irradiation of the dry seeds. One circumstance favoring the occasional development of a few partially fertile flowers on an otherwise monstrous-flowered plant appears to be the infection of the ovaries by an insect larva. Infected ovaries have a hole in them where the larva presumably entered, and these ovaries are more strongly angled than those not infected. Adults of the insect were obtained and have been identified as *Mompha circumscriptella* of the microlepidopteran family Momphidae. It remains to be determined whether development is stimulated by some secretion from the larva or merely as a consequence of the wounding and mechanical irritation.

HERSKOWITZ, IRWIN HERMAN. Genetic Recombination Induced by X-rays in Female Germ Cells of *Drosophila*. *Biology Department, Saint Louis University, St. Louis, Missouri, U.S.A.*

The kinds and frequencies of X-ray induced genetic recombination in female germ cells of *Drosophila* depend upon their stage in differentiation. In most mature cells many breaks are produced. Some rejoining occurs soon after certain treatments, but is delayed after higher doses are delivered more quickly. When the two ends undergoing an exchange (non-restituting) union are from non-homologous chromosomes, the result is "half-translocation"; when they are from the same tetrad, the result is deletion or inversion if one strand is broken twice, and is either duplication or deficiency or both if two strands are involved. Here the breaks are presumably sometimes at nearby, but not necessarily identical, loci producing a "pseudocrossover." Many breaks fail to rejoin, at least when there is more than one per cell. Thus, the union producing a half-translocation usually is not accompanied by the reciprocal joining of the other two broken ends.

In viable exchanges the breaks often occur in heterochromatic regions because these, as compared with euchromatic ones, are either more breakable, less restitutable, in closer proximity, more viable in aneuploid condition, or any combination of these factors. While such heterochromatic recombinations probably produce relatively few recessive lethals they frequently cause dominant lethality via "non-disjunction" or the retention in the egg after reduction of an unjoined broken end, or a dicentric chromosome, or a eucentric one grossly aneuploid.

When progressively immature germ cells are irradiated half-translocations and dominant lethals decrease in frequency, X-ray induced "crossovers," presumed to occur between exactly homologous loci, increase while pseudocrossover frequency apparently is unchanged. Dominant lethals, half-translocations, pseudocrossovers and X-ray induced crossovers increase when the X-ray dose is delivered either more intensely, or to females previously dehydrated. Accordingly, all are attributed in large measure to multiple independent X-ray hits, many dominant lethals and all half-translocations and pseudocrossovers resulting from multiple independently produced breaks.

HETZER, H. O., J. H. ZELLER, and R. L. HINER. Three Generations of Selection for High and Low Fatness in Duroc Swine. *U.S. Department of Agriculture, Agricultural Research Center, Beltsville, Md., U.S.A.*

Results of selecting for high and low fatness in two lines of Duroc swine through 3 generations are presented. Starting in 1954 with a group of 82 pigs from 16 litters, foundation animals for the 2 lines were selected largely on an intra-litter basis after foundation animals for an unselected control line had been randomly selected from the same litters. The primary criterion of selection was individual backfat thickness at a live weight of 175 pounds and, except for a few late farrowed pigs in the 3rd generation, all normal pigs weaned in each line each generation were probed. Usually 6 boars and 12 gilts were selected for parents of each generation in the selected lines and 12 boars and 12 gilts in the control line, care being taken to keep the relationship between mates at a minimum. The selection actually practised on the basis of backfat thickness resulted in mean differences between the high and low lines of .04, .19 and .37 inches, in the first, second and third generations, respectively. Starting with an average of 1.49 inches, the average increased to about 1.70 inches in the high line and decreased to about 1.33 in the low line. The largely intra-litter selection in the foundation stock was about .19 effective compared with estimates of .58 and .62 from the response observed in the second and third generations. The latter two values agree rather well with the heritability estimate of .59 from regression of progeny on mean of parents within lines and generations, indicating that backfat thickness is rather highly heritable. However, realized heritabilities computed according to Falconer differed somewhat between the high and low lines, .57 versus .41 suggesting that selection was relatively less effective for low backfat than for high. Carcass data obtained on samples of pigs showed the low line exceeding the high line in percentage yield of lean cuts and, at the same time, averaging lower in yield of fat cuts.

HEXTER, WILLIAM M. Probable Gene Conversion in *Drosophila*. *Amherst College, Biology Department, Amherst, Mass., U.S.A.*

Attached-X analysis of *garnet* in *Drosophila* yielded data not easily explicable by orthodox crossing-over. Four “different alleles” (g^2, g^3, g^4 and $g^{53\mathrm{d}}$) were analyzed in three independent tests. In each test one arm of the attached-X contained $g^{53\mathrm{d}}sd$, the other wy^2 and one of g^2, g^3 or g^4. The latter three alleles, indistinguishable from each other, give “brown” eye while $g^{53\mathrm{d}}$ gives “orange.” Further phenotypic separation can be made by combination with w^a. Genetic tests yielded wild type females in the following proportions which are statistically similar: g^2-g^{53d}–4/78,843; g^3-g^{53d}–5/95,139; g^4-g^{53d}–3/50,031. Based upon the observed recombination of the markers preliminary analysis results in an interpretation of pseudoalleles with g^{53d} to the left of g^2, g^3 and g^4, the latter three presumably at the same locus. Such an interpretation demands recovery of the presumed double mutant, g^{53d} g^2, ^{3} or ^{4}. Phenotypic evidence indicated no double mutant. Attempts to recover g^{53d} from such a presumed combination yielded: $g^{53d}g^2$–0/90,104; $g^{53d}g^3$–0/153,994; $g^{53d}g^4$–0/115,305. The probability of 0/359,403 due to chance is less than 0.001. It is argued therefore that at least three wild-type females arose by conversion of g^{53d} to g^+ accompanied by crossing-over between wy^2 and *sd*. Upon test another wild-type female proved to have $wy^2g^{\text{“brown”}}$ in one arm and *sd* in the other. This can be explained by conversion of g^{53d} to g^+ unaccompanied by crossing-over or, less likely, by a double crossover within a short distance. A final female phenotypically *sd* with wild-type eye and proven heterozygous for g^{53d} can be explained by conversion of g^{53d} to g^+ accompanied by crossing-over between *sd* and the kinetochore or, less likely, by a triple crossover within a short distance. It is not proven that the garnet locus is, in fact, pseudoallelic. (This work has been supported by research grant RG–C–4599 from the National Institutes of Health.)

HIGHKIN, HARRY R. Transmission of Phenotypic Variability in a Pure Line. *California Institute of Technology, Pasadena, Calif., U.S.A.*

During the course of physiological and genetic studies of heat resistance in peas (*Pisum sativum*), conducted in the Earhart Plant Research Laboratory, it was found that the F_1 population of a cross between two pure lines exhibited a variance in growth which exceeded considerably that of either parent. Analysis of the data showed that the excessive variance could be attributed entirely to the differences among the environments of the different pollen sources. Results of this and other experiments pertaining to dauermodification type inheritance will be discussed.

HILL, BERTON F. *See* WOLFF, GEORGE L.

HINER, R. L. *See* HETZER, H. O., *et al.*

HINTON, CLAUDE W. Cytological Demonstration of Cleavage Anaphase Bridges in *Drosophila melanogaster. Department of Zoology, University of Georgia, Athens, Ga., U.S.A.*

The behavior of an unstable ring-X chromosome called w^{vc} of *Drosophila melanogaster* has been explained by anaphase bridge formation during cleavage mitoses followed by breakage of the bridge to cause dominant lethality or by loss of the bridge to produce either gynandromorphs or X0 males. An attempt to confirm this model consisted of cytological examination of Feulgen whole mount preparations of third through eighth cleavage eggs derived from rod-X females crossed either to w^{vc} males or to males carrying the stable X^{c2} ring chromosome. The frequency of late anaphase and telophase figures with bridges was 1.94% ($N = 2{,}516$) and 0.28% ($N = 1{,}084$) for the two groups, respectively; these frequencies are not corrected for the expectation that approximately one-half of the embryos carry the Y chromosome rather than a ring-X. Studies of other mitotic abnormalities found in this material are in progress. (Work supported by U.S. Public Health Service Research Grant C-3000.)

HIROTA, YUKINORI. The Effect of Acridine Dyes on Mating Type in *Escherichia coli. Department of Genetics, University of Wisconsin, Madison, Wis., U.S.A.*

The mating types of *Escherichia coli* are determined by the presence of a transmissible agent, F. The study reported here reveals that it is possible to obtain F— cells at will from F+ with high efficiency (90–100%) growth in broth containing acridine dyes (acriflavine and acridine orange). (1) the F— strains obtained are genetically fixed in this mating type, also the other F— reported by other workers. (2) No effect has been observed yet on characters which show chromosomal segregation or on the production of colicine, E. (3) F— cells appear in F+ populations in one-half to one hour after exposure to acridine dyes, and then the rate increases rapidly. (4) Some strains of intermediate compatibility were obtained. (5) The stable Hfr_1 strain (High frequency of recombination), W1895, is not affected by the treatment. The efficiency is influenced by the medium and by the temperature. The killing action and F removing action of this environmental condition are not correlated.

A simple working hypothesis to interpret these phenomena is that F is inherited as a plasmid.

HIRSCHORN, KURT, and CHAS. F. WILKINSON, Jr. The Mode of Inheritance in Essential Familial Hypercholesterolemia. *Department of Medicine, New York University Post-Graduate Medical School, New York, N.Y., U.S.A.*

During the past twenty years, a number of families carrying the trait of essential familial hypercholesterolemia with xanthomatosis have been studied by various investigators to determine the method of inheritance.

Almost all of these studies have accepted and confirmed the concept of the inheritance of hypercholesterolemia as an autosomic dominant. There remain, however, two schools of thought: one considering it to be a complete dominant, and the other calling it an incomplete dominant, with homozygosity a prerequisite for xanthomatosis, increased incidence of coronary heart disease, and very high cholesterol values.

We wish to report several new sibships with this defect. Once again, the dominance of hypercholesterolemia is borne out. These sibships seem to show the incomplete mode of dominance in that all very high cholesterol values and xanthomatosis are found only in homozygous individuals.

It is our opinion that these two methods of inheritance are not incompatible with each other. We may assume that only one gene locus is involved since the offspring in all studies show a monozygotic ratio. There exist many samples in experimental genetics of multiple alleles of one factor, showing different degrees of dominance, and even occasionally mutating to recessive form. After analysis of our material, as well as re-analyzing all previously reported families, we strongly believe that such multiple alleles may be responsibe for the various types of inheritance reported in essential hypercholesterolemia.

HOCHMAN, BENJAMIN. Wild-Type Isoalleles in Natural and Laboratory Populations of *Drosophila*. *Department of Genetics, University of Utah, Salt Lake City, Utah, U.S.A.*

An examination of the fourth chromosomes of 36 laboratory and 4 natural populations of *Drosophila melanogaster* was made in order to estimate the frequency of wild-type isoalleles at the *cubitus interruptus* (*ci*) locus. The method employed permits the classification of ci^+ alleles into two categories: one group (class A) is always dominant over the mutant allele *ci*; the other (class B) comprises those ci^+ alleles which allow the expression of the mutant phenotype (interruptions in wing vein four) in some the heterozygous ci^+/ci flies. Class B alleles may be seriated further by penetrance and expressivity studies.

All of the alleles from natural populations were in class A, while in two of the laboratory stocks a class B ci^+ gene was uncovered. In homozygous condition each allele conferred the normal phenotype. The two domesticated stocks in question are of widely separated geographical origins.

This low incidence of class B ci^+ alleles is somewhat in conflict with earlier findings of Stern and Schaeffer (1943). They examined three laboratory stocks and found each to contain a measurably distinct class B allele. Two of the three genes found by Stern and Schaeffer gave very low percentages of flies with interrupted veins in heterozygous combination with the *ci* allele. Such class B alleles with very low "penetrance" may have escaped detection owing to the less sensitive testing technique utilized in the present investigation.

The apparent absence of class B ci^+ isoalleles in natural populations (over 80 trapped males have been tested) is not surprising considering the results obtained in population cage experiments with ci^+ isoalleles. If the adaptive values ascertained in the artificial populations studied are comparable with those existing in nature, class B ci^+ isoalleles should be rare.

HOGE, A. R. *See* SCHREIBER, GIORGIO, *et al.*

HOLLANDER, W. F. Sperm Abnormality of a Mutant Type Involving the *p* Locus in the Mouse. *Department of Genetics, Iowa State College, Ames, Iowa, U.S.A.*

A mutant pink-eyed dilute obtained from X-irradiated sperm (500r) has been analysed. Though identical with *p* in color effects, it is abnormal in other ways: homozygotes are about a third lower in body weight than comparable heterozygotes, and show a slight choreic behavior. When weaned they have great difficulty in chewing food biscuits through ¼-inch mesh wire. Adults often show abnormal wearing of the upper incisors. All homozygous males tested (about 50) have been sterile, except one which was partially fertile for a brief time. Sterility seems in part due to failure to copulate, but in addition most of the sperms produced are malformed, lacking the hook. Motility of the sperm is normal in spite of head deformities. Homozygous females have usually been able to produce one or a few litters of viable young, but milk production is poor and the young are rarely raised. The mutant acts as a simple recessive both to *p* and the normal allele. The pleiotropic effects suggest that the mutant may be a deficiency. If so, not a very large segment would be involved, since it is not lethal, and crossing over with the *c* locus is apparently not reduced. The symbol p^s is employed. (This study was assisted by Contract No. AT(11-1)107 from the Atomic Energy Commission.)

HOLLOWAY, B. W. Genetic Recombination in *Pseudomonas aeruginosa*. *Department of Bacteriology, University of Melbourne, Carlton, Australia.*

The occurrence of genetic recombination in *Pseudomonas aeruginosa* has been demonstrated. Recombination of both selected and non-selected characters has been demonstrated and it is apparent that some system of ordered genes is operating. A compatibility system dependent on a factor FP occurs such that mating takes place between FP+ and FP— strains. FP— strains may be converted to FP+ by contact with FP+ strains. The nature of the inheritance of the FP factor and its influence on the segregation of genetic markers has been investigated. One of the interfertile strains is susceptible to a pyocin liberated by another interfertile strain and the general characteristics and inheritance of this agent have been studied in relation to other inherited characteristics of the strains. The general characteristics of the genetic mechanisms studied in these strains point to its similarity to those occurring in *Escherichia coli.*

HOLT, SARAH B. The Inheritance of Ridge-Count in Finger-Prints. *Galton Laboratory, University College, London, England.*

The method of ridge-counting, which gives a measure of pattern size, has been used for genetic studies on the dermal ridge patterns of fingers. It has been shown by statistical analysis of data from parents and children, sibs and twins, that the total ridge-count (i.e., the sum of the counts on the ten fingers of an individual) is inherited. The genes concerned are additive with independent effect, but without dominance. There is evidence also that the variability of ridge-counts from finger to finger has a genetic basis.

The demonstration includes frequency distributions for total ridge-count for males and females in a British population sample and diagrams to illustrate the correlations for total ridge-count between (*a*) parents and children, (*b*) sibs, (*c*) monozygotic twins, and (*d*) dizygotic twins.

HOUGH, L. FREDRIC, and GERALD M. WEAVER. Irradiation as an Aid in Fruit Variety Improvement. *Department of Horticulture, Rutgers University, New Brunswick, N.J., U.S.A.*

Peach trees grown one and two years in the Brookhaven Gamma Field have produced mutations in the season of ripening, firmness and texture of the fruit flesh, and the freestone condition of the pit. A late-ripening mutant of Elberta holds promise of becoming a commercial variety.

In vitro and *in vivo* germination has been observed and seedlings have been obtained from dry sweet cherry pollen subjected to gamma radiation at dosages of 100,000 to 400,000 roentgens. Relatively low dosages of ionizing radiations have been observed to have a stimulating effect in two instances. A stimulation in fruit set of sweet cherries was observed using dry pollen which had been treated with 25,000 and 50,000 roentgens acute gamma irradiation. The increased fruit set was apparently due to induced parthenocarpy as the seed set was very low. Thermal neutron dosages of 2 hours' duration at a 7.52×10^6 neutrons/cm.^{2}/sec. flux have been found to greatly stimulate initial seedling vigor so that a greater number of seedlings can be transplanted. This effect has only been observed with seedlings from weak seeds. This promises to be of practical value in breeding for very early-ripening peaches.

Current research to determine the most efficient method of irradiating fruit species includes chronic gamma irradiation, semi-chronic gamma irradiation during a particular stage of plant growth, and acute irradiation of buds, pollen, and seeds. Fruit seeds show the greatest response to irradiation when they are irradiated just as they are begining to germinate.

HOUGH, L. FREDRIC. *See* BAILEY, CATHERINE H.

HOVANITZ, WILLIAM. The Helical Structure of Giant Chromosomes. *Department of Biology, California Institute of Technology, Pasadena, Calif., U.S.A.*

Isolated chromosomes have indicated a compound helical structure with many orders of helices ranging in size from molecular coils of 50 Å in diameter through multiples of 100 Å, 200 Å, etc., up to microscopically visible coils such as are seen normally in microscopic cytological preparations. The unique position of the Dipteran giant chromosomes in presumably being constructed of transverse bands rather than helices seemed untenable in view of the universality of the helical structure of all other chromosomes. A revised outlook on this matter has indeed shown that the "bands" of the giant chromosomes of *Drosophila* and *Chironomus* are turns of helices which have been visibly compounded from a hierarchy of smaller helices. The darkly staining portions of these chromosomes differ visibly from the lighter staining portions by the tighter coils of which they are composed. There is no need to postulate a different chemical structure of these parts, in fact at varying times of the growth of the organism, the one may become the other. The lighter staining portions are loosely coiled but show a continuity of coiled strands similar to that of the darker portions. The largest helices (bands) are apparently not a unit transversely, but are visibly formed by the meeting of innumerable smaller coils in close union. These coils can be relaxed from their tight "banded" appearance by the application of salt solution before fixation. Helices of various orders of size can be seen clearly in this condition.

HOWARD-FLANDERS, PAUL. The Effects of Nitric Oxide and Oxygen on Radiation-Induced Lethal Injuries in Bacteria and Yeast. *Donner Laboratory, University of California, Berkeley, Calif., U.S.A.*

The presence of oxygen during exposure is known to affect the production of a variety of radiation-induced injuries, including chromosome aberrations, dominant and recessive lethals and certain other mutations in a number of different organisms. Further insight into the mechanism of the oxygen effect may be obtained from the observation that, for all the micro-organisms so far tested, it has been found that nitric oxide enhances the effects of irradiation carried out under anoxia. In experiments on the bacillus *Shigella flexneri*, in which the criterion of survival was the ability to form colonies, it was found that the effects of oxygen and nitric oxide on the sensitivity to X-irradiation were similar in two respects. The same concentration of gas was needed to double the sensitivity, and the degree of enhancement of sensitivity at high gas concentrations was the same within experimental error. The similarities and contrasts in the actions of the two gases on radiation injury and on cellular metabolism will be discussed.

HRUBÝ, KAREL. Caterpillar Colour Inheritance in *Biston betularius* L. *Genetics Institute, Charles University, Prague, Czechoslovakia.*

The geometrid *Biston betularius* L. is polymorphic in the adult as well as caterpillar stage. Colour inheritance of the imago is well known. The caterpillars occur in different colour shades from pale greyish green to dark brown. They may be classified into two distinct categories: (i) without pigmentation, (ii) coloured. These categories are not merely modifications. The genotypical independence of caterpillar and imago pigmentation has been proved. (Dark and normal moths emerged from both coloured and colourless caterpillars in the same monohybrid back cross ratio 1:1.)

Crossings concerning only the caterpillar colour gave the following results. In the progeny of an initial cross 201 pigmented and 181 colourless caterpillars occurred (9:7, $\chi^2_{(1)} = 1.95$, $P = 0.16$). Two types of crossing were then performed: (i) pigmented × pigmented, (ii) colourless × colourless. In the progeny of the first cross there were 121 coloured and 40 colourless caterpillars (3:1, $\chi^2_{(1)} = 0.002$, $P = 0.92$). But the same ratio appeared in the progeny of the colourless cross. There were 66 coloured (22 of them very dark) and 14 colourless (3:1, $\chi^2_{(1)} = 2.2$, $P = 0.15$, but greater agreement with the ratio 1:2:1, $\chi^2_{(2)} = 2.4$, $P = 0.30$). But monofactorial inheritance cannot be considered. The occurrence of pigmented, even strongly pigmented, caterpillars in the progeny of a cross colourless × colourless points to the polyfactorial complementary kryptomeric interaction.

There should be three pairs of complementary genes, viz., the basic factor for the production of the pigment *M* which is incompletely dominant, and two pairs of realisators *A* and *B*. The caterpillar is coloured only when all three pairs are represented in the genotype by the dominant alleles. The genes of these three pairs have moreover an additive effect, thus *MMAABB* producing very dark pigmentation and *MmAaBb* only a light brown colour. All results mentioned are in accordance with this supposition.

HSIA, DAVID YI-YUNG, SHIRLEY G. DRISCOLL, and EVA M. S. GAWRONSKA. The Detection of Heterozygous Carriers in Hereditary Diseases. *Genetic Clinic, Children's Memorial Hospital, and Northwestern University Medical School, Chicago, Ill., U.S.A.*

The detection of heterozygous carriers of a hereditary disease is important for a variety of reasons: (1) it provides the immediate family with the information as to who are likely to have affected offspring. The prompt institution of treatment made possible by this foresight may bring about the successful therapy of such conditions as galactosemia or phenylketonuria; (2) it is useful as a means of determining the incidence of carriers for any given trait within the community and gives an indication as to whether the load of mutations is increasing or decreasing; (3) it is of great value in the understanding of pathogenesis of a given hereditary disease. The ability to detect the same biochemical defect in the heterozygote usually indicates that one is dealing with a primary and not secondary gene effect; and (4) the heterozygous carriers represent at least a potential medical hazard. Muller has estimated that each individual on the average carries eight mutant genes in heterozygous condition. Under normal conditions, these may only slightly affect his general performance in life, and perhaps increase his susceptibility to non-genetic diseases. In periods of stress, these could well represent the difference between extinction and survival.

The present paper will discuss some of the principles and newer biochemical methods which are proving to be useful in the detection of heterozygous carriers of hereditary traits in man. Detailed data obtained in our own laboratory on the following conditions will be presented: (1) phenylketonuria; (2) idiopathic hyperlipemia; (3) vitamin D resistant rickets; (4) cystic fibrosis of the pancreas; (5) glycogen storage disease (von Gierke's Disease); (6) galactosemia.

HSU, T. C. Changes of Chromosomal Constitution and Host Compatibility of the Novikoff Rat Hepatoma Cells Grown *in vitro.* *University of Texas M. D. Anderson Hospital and Tumor Institute, Houston, Tex., U.S.A.*

The Novikoff rat hepatoma cells carried in Sprague Dawley rats contain two modes of chromosome number distribution, one at 39 and the other at near 78. The "diploid" cells (39 chromosomes) exhibit several new chromosomes to the normal rat complement ($2n = 42$): a very large and two slightly smaller metacentric chromosomes and a small chromosome with a long satellite. The tetraploid cells show the doubling of these elements.

Three *in vitro* cell strains have been successfully maintained from the original tumor tissues. The chromosome pattern of the cells underwent a series of changes. First, there was a definite decline in the frequncy of the "diploids" and an increase in the "tetraploids"; then heteroploids arose. The chromosome number of the heteroploids ranged from far below to far above that of the "tetraploids." Besides, within each population, the combinations of individual chromosomes were as varied as the numbers. After 8–10 months of continuous cultivation, the populations became totally heteroploid with a rather narrow range of chromosome numbers. However, each strain has its own characteristic chromosomal distribution. At the present time, Strain N–1 is characterized by 67± chromosomes, N–3 by 60± chromosomes, and N–4 by 74± chromosomes.

Inoculation of the *in vitro* cells into young Sprague Dawley rats produced tumors in the early period of cultivation. During the stages of transformation a decrease in transplantability was noted. Cells from Strains N–1 and N–3, after reaching the present chromosome constitution, produce a small tumor but regress after two weeks. These rats would later reject the grafts of the *in vivo* Novikoff hepatoma. Cells from Strain N–4, however, still produce tumors but with marked decrease in malignancy.

(Supported in part by Grant #DRG-269C from Damon Runyon Memorial Fund for Cancer Research and Grant #P-133 from American Cancer Society.)

HUBBY, J. L. *See* GLASSMAN, E., *et al.*

HUESTIS, R. R., and RUTH S. ANDERSON. Genetic Change in an Axial Skeleton. *University of Oregon, Eugene, Ore., U.S.A.*

The modal presacral vertebral formula in Oregon *Peromyscus maniculatis* is C7T13L6. A relatively long spinous process is typically present on the second thoracic vertebra. This process may be lacking in some individuals, or in a smaller number may be located on the third thoracic vertebra. These three types of skeletons will be called P_2, P_0 and P_3 respectively. In a cage-bred sample of 332 individuals prepared to establish a norm, 80% of the skeletons were P_2; 13% were P_0; and 7% were P_3. By selection of P_0 individuals for parentage, which may be done by feeling between the vertebral borders of the scapulae, increases were obtained in the incidence of both P_0 and P_3 types and in the average number of ribs and presacral vertebrae. Selection of P_3 individuals for parentage by progeny tests continued this trend so that in a sample of 163 *P. maniculatis* obtained from P_3 parents, 7% of the skeletons are P_2; 26% are P_0; and 70% are P_3. The total modal number of presacral vertebrae in this selected group has become 27. In a comparison of young produced by other matings: $P_2 \times P_2$; $P_2 \times P_0$; $P_2 \times P_3$; $P_0 \times P_0$; and so on to $P_3 \times P_3$; the proportion of P_2 young diminishes; the proportion of P_3 young increases; and the proportion of P_0 young increases to a maximum in the $P_0 \times P_0$ mating and then diminishes.

Hughes, Roscoe D., and Harold W. Syrop. A Familial Study of the Agenesis of the Parotid Gland Duct. *Medical College of Virginia, Richmond, Va., U.S.A.*

Congenital absence of one or more salivary glands in man is an exceedingly rare anomaly even when this condition is a part of an associated generalized ectodermal dysplasia. Congenital absence or dysfunction of the parotid glands alone, or in association with dysfunction of the lacrimal glands, is still more uncommon. Only four cases of such anomalies have been reported in the literature and two of these were father and daughter. In the present study of a single family group there are nine affected individuals in three generations. Seven of these were available for examination. In each of these individuals there is an absence of the orifice of Stenson's duct and a marked diminution of saliva of the oral mucosa. The parotid gland is not palpable. This condition results in a characteristic which the members of this family term "dry mouth" and is associated with an abnormally high caries index. No other defects could be detected in the seven individuals except in two there is an absence or dysfunction of the lacrimal glands as well as the parotid glands. The distribution of the anomaly in this family group indicates that it can best be explained on the basis of a single autosomal dominant gene with a high degree of penetrance.

Hunter, A. W. S., and Marie Bragdo. The Cytology of Three Hybrids between Diploid and Hexaploid Plums (*Prunus* spp.). *Horticulture Division, Experimental Farms Service, Canada Department of Agriculture, Ottawa, Canada,* and *Norges Landbrukhøgskole, Vollebekk, Norway.*

Meiosis was examined in the pollen mother cells of two tetraploid plums of the parentage St. Anthony ($2n = 16$) × Mount Royal ($2n = 48$) and in one pentaploid of the parentage Shiro ($2n = 16$) × Reine Claude ($2n = 48$). The tetraploids have a remarkably regular meiosis, 16 bivalents being formed in 73% of the cells at first metaphase in one and in 64% in the other. First anaphase separation results in 16 chromosomes at each pole in approximately 80% of the cells of both tetraploids. However, only 40% of the pollen stains with aceto-carmine and there is much variation in pollen grain size.

Meiosis in the pentaploid is much more irregular. Multivalents and univalents were found in all first metaphase cells examined, and anaphase separation of the chromosomes was usually unequal. Altogether 60% of the pollen stained with aceto-carmine, but again there was much variation in size.

All three hybrids bear moderate crops of fruit containing viable seeds under orchard conditions. In controlled crosses, no fruit resulted when the hybrids were used as male parents on diploid or hexaploid varieties. Viable seeds were produced by the three hybrids when they were used as female parents and pollinated by hexaploid but not by diploid varieties. These hybrids may be useful in the breeding of plums that combine the high fruit quality of hexaploids with the winter hardiness of some diploid species.

Hunziker, J. H. Karyotype Analysis in *Cupressus* and *Libocedrus*. *Instituto de Botánica, Ministerio de Agricultura, Buenos Aires, Argentina.*

Results: *Cupressus arizonica* = 22 (all V ?, 2 S, 2 sc ?); *C. funebris* = 22 V (2 S, 2 sc); *C. glabra* = 23 V (2 S, 2 sc), 1–2 nucleoli; *C. lusitanica* var. *lusitanica*

= 20 V (2 S, 2 sc) + 2 J; 20 V (2 s) + 2 J, 1–2 nucleoli; var. *Benthami* = 22 V (2 s), 1–2 nucleoli; 22 V (1 S, 1 s), 1–2 nucleoli; *C. macrocarpa* = 22 V (2 S); *C. sempervirens* = 22 V (8 S), 1–7 nucleoli; 22 (all V ?, 2 S, 2 sc ?); *C. torulosa* = 20 V (2 S) + 2 J; *Libocedrus chilensis* = 22 V (2 S, 4? sc), 1–2 nucleoli). In the preceding karyotype formulae the following abbreviations have been used:

$$V = \text{V-chromosome, brachial index} = \frac{\text{Length short arm}}{\text{Length long arm}} = 1\text{–}0.5;$$

J = J-chromosome, brachial index = < 0.5; S = linear satellite, distal segment longer than the proximal; s = round satellite, distal segment shorter than the proximal (in both S and s the satellites are separated from the rest of the chromosome arm by a long, nucleolar, thread-like, secondary constriction); sc = short secondary anucleolar constrictions (not always conspicuous).

Conclusions. The fact that two and four different karyotypes were observed in *C. sempervirens* and *C. lusitanica*, respectively, points to the existence of chromosomal variability within these species. In *C. funebris* and *C. torulosa* there are slight differences in the karyotype as described by Mehra and Khoshoo (J. Gen. *54*: 165–180) and as described here. In these two species there might also be intraspecific karyotype variation.

In the chromosomal race of *C. sempervirens*, having eight long secondary constrictions, all of them are presumably nucleolar because up to seven nucleoli were observed at resting stage. The supernumerary chromosome found in *C. glabra* is much smaller and appears to have a shorter centromere than the other chromosomes. Apparently in *Libocedrus chilensis* the long nucleolar secondary constriction is completely adjacent to the centromere. Further studies are being made in order to clarify this matter.

HUTCHINSON, A. H. The Principles Involved in Polygenic Selection from a Polyzygous Population of Douglas Fir. *Department of Biology and Botany, University of British Columbia, Vancouver, Canada.*

A genotypic evaluation of wind pollinated Douglas fir populations is premised on polygenic segregation involving various growth rates, frost sensitivity, and cyclic bud activity. In each case three or four allelic factors are required to satisfy the polyzygous states, which are evident from more than 80,000 readings. Simple equations in terms of N, the number of polygenic alleles, and n, the degree of parental heterozygosity, relate the phenotypes and genotypes of the progenitors to the class frequency distribution coefficients of the progenies $(1 + I)^n \times 2^{2N-n}$. All population curves are reduced to the common base, 2^{2N}.

Each controlled biparental class frequency polygon of a specific polyzygous population is balanced and includes $(n + 1)$ phenotypic classes from a possible $(2N + 1)$ classes, each of which belongs to one of (factorial $(N + 1)$) effective genotypic classes. These genotypes may combine to produce factorial $2N + 1$ class frequency series, as progenies. Wind pollinated, multiparental stocks are characterized by class frequency polygons which show predictable skewness, multiple peaks and extended plateaus.

Selection may be controlled genotypically on these bases. Examples of natural selection are presented.

HYDE, BEAL B., and R. L. PALIWAL. Sulfhydryls in Plant Chromosomes. *Department of Plant Sciences, University of Oklahoma, Norman, Okla., U.S.A.*

A number of SH reagents are known to affect both the physiology and, directly or indirectly, the structure of chromatin. We are studying the effect of N-ethylmaleimide, triiodobenzoate, KCN and heavy metals such as $Hg(NO_3)_2$ on the distribution of SH groups within the nucleus. The quantity of SH groups is determined by means of the Barrnett and Seligman histochemical procedure.

N-ethylmaleimide treatments of 4 and 24 hours at levels of 10^{-3}, 10^{-4}, and 10^{-5}M were given to onion root tips. The two lowest concentrations markedly decreased the over-all frequency of SH groups in the nuclei of the meristems. It appears that little damage is done to the chromatin at these concentrations. Mitosis is almost completely inhibited by the middle concentration and decreased in frequency by the lowest concentration. The highest concentration, on the other hand, killed the tissue.

KCN, a classic agent for uncoiling chromosomes, noticeably reduces the SH staining when given after fixation. Data will be presented showing the effect of this reagent on living root tips which have been subsequently fixed.

The effect of $HgCl_2$ depends upon its concentration. A saturated solution results in fixation but also leaves the nucleus in such a condition that it stains intensely with the SH procedure. A 0.05 M solution of $Hg(NO_3)_2$ fixes but also either dissolves protein or suppresses SH staining. A 0.005 solution of $Hg(NO_3)_2$ fixes some cells but not others and does not appear to affect SH groups differently than do other common cytological fixatives.

HYDE, BEAL B. *See* PALIWAL, R. L.

HYUN, SIN KYU. Feasibility of Large-Scale Controlled Pollination as a Means of Mass Producing Hybrid Pine Seed. *Institute of Forest Genetics, Suwon, Korea.*

Because of the great economic potentialities of the hybrid of *Pinus rigida* × *Pinus taeda*, mass production of hybrid seed has been performed through large-scale controlled pollination. A 10-year-old pitch pine plantation, about 5 hectares in extent, has been employed as a maternal stand, and approximately 60,000 ovulate strobili were isolated with 30,000 pollination bags. Pollen of *P. taeda* were transported by air from the Institute of Forest Genetics, Placerville, Calif., U.S.A. Pollens from several individuals were mingled before using. Pollination was performed on 3 days as the ovulate strobili do not all reach the receptive stage simultaneously. On an average, 0.3 cc. (0.1 gr.) of pollen were used for each pollination bag to complete the pollination.

As a result of the pollination, 45,000 matured cones (133 litres in volume and 762 kg. in weight) were produced, and from these cones, 2,250,000 seeds (33.1 litres in volume) were produced. Among them, 1,305,000 (19.0 litres in volume) were sound seed and 945,000 (14.1 litres in volume) were hollowed seed, showing 58 per cent fertility. On an average, 43 sound seeds were produced from one pollination bag and from these seeds 25 1–0 seedlings obtained, producing a total of 1,125,000 1–0 seedlings. These hybrid seedlings, through the test at the nursery bed as well as field planting up to 4 years old, have proven that the hybrid combines the cold resistance of pitch pine with the better form and growth of loblolly pine. Out of 100 hybrid seedlings 80 were large enough for field planting at the end of 1 year in the seed beds, whereas only 20 out of 100 ordinary pitch pine seedlings were large enough as 1–0 stock. On this basis, cost calculated per one item of planting stock was HW 2.65 for hybrid pine and HW 2.82 for ordinary pitch pine.

Thus, in Korea, the mass production of hybrid pine seed through hand pollination is feasible, not only technically but also economically, and a large-scale controlled pollination would be a short cut to the mass production of hybrid seed for reforestation until the seed orchard of parental species come into production.

IKEDA, YONOSUKE, and TOSHIAKI TAKAHASHI. Complementary Genes Controlling Alpha-methyl-glucoside Fermentation in Saccharomyces. *Institute of Applied Microbiology, University of Tokyo, Tokyo, Japan.*

In contrast to the accepted belief that the fermentation of α-methyl-glucoside is under the control of one pair of alleles (MG/mg), the hybrid produced between a Carbondale haploid strain (rapid fermenter) and a haploid strain (non-fermenter), having been derived from a hybrid between a homothallic and a heterothallic Saccharomyces showed irregular segregation patterns with regard to the sugar fermentation. Three pairs of alleles, MG_1/mg_1, MG_2/mg_2, and MG_3/mg_3, were assumed as genes controlling the fermentation quantitatively, and haploid cultures carrying the genotypes (1) $mg_1\ mg_2\ mg_3$, (2) $MG_1\ mg_2\ mg_3$, (3) $mg_1\ MG_2\ mg_3$, (4) $mg_1\ mg_2\ MG_3$, (5) $MG_1\ MG_2\ mg_3$, (6) $MG_1\ mg_2\ MG_3$, (7) $mg_1\ MG_2\ MG_3$, and (8) $MG_1\ MG_2\ MG_3$ were actually recovered. The strains equipped with either (1) or (2), (4) or (6), (3), (5), (7), and (8) are non-fermenter, extremely slow fermenter, slow fermenter, medium fermenter, semi-rapid fermenter and rapid fermenter respectively.

The role of these genes in sugar fermentation and the identity or non-identity of some of these genes with maltose genes are under investigation.

INOUYE, NOBUO. *See* LERNER, I. MICHAEL

IRWIN, M. R. *See* BEDNEKOFF, A. G., *et al.*; STONE, W. H.

ISEKI, SHOEI. Lysogenic Conversion and Transduction of Genetic Characters by Temperate Phage *iota* in *Salmonella* Groups A, B, and D. *Department of Legal Medicine, School of Medicine, Gunma University, Maebashi, Japan.*

The production of somatic antigen 1 of *Salmonella* group A, B, and D is governed by temperate phage *iota*. However, in groups E, G, and H and in further groups which lack antigen 12, the relation between the production of antigen 1 and *iota* phage is not clear. *Iota* phage, which induces lysogenic conversion with regard to somatic antigen 1 of *Salmonella*, can also transduce, like *epsilon* phage in *Salmonella* group E, such genetic characters as streptomycin resistance, nutritional factor, and flagellar antigen separately into the recipient strain. The transduction of characters can occur regardless of whether the recipient strain is easily lysogenizable or hardly lysogenizable. In the former case, the transduced bacteria turn lysogenic, acquiring somatic antigen 1, while in the latter, even after the transduction of characters, they generally remained sensitive without somatic antigen 1. The transduction of characters is induced by *iota* phage sometimes also into recipient strains which possess somatic antigen 1, but at much lower frequencies.

ITO, TAKASHI. A Kinetic Analysis of Immobilization due to Antigen-Antibody Reaction in *Paramecium caudatum*. *Biophysical Laboratory, St. Paul's University, Tokyo, Japan.*

Single antigen-antibody reactions are detected (operationally) by the immobilization of free-swimming *Paramecium caudatum*. Kinetic theories of immobilization of paramecium are developed, and experimental evidence is presented to verify them. The interesting character of immobilization is revealed by the analysis of the behavior of paramecia in intermediate cytoplasmic states (expressing two types of antigens simultaneously) in the presence of mixed antiserum.

IVES, PHILIP T. The Mutation Rate in *Drosophila* Sperm after Cobalt-60 γ Radiation. *Department of Biology, Amherst College, Amherst, Massachusetts, U.S.A.*

Spermatozoa from two-days-old inbred Oregon-R males were tested by Basc after exposure to Co-60 γ in doses ranging from 300 r to 12,500 r in intervals of 700 r to 2,500 r. For each of 7 doses a minimum of 1,202 X-chromosomes was tested and a minimum of 112 lethal chromosomes was observed. Plotted directly the data fit a straight line with a slope of 1.85% lethal chromosomes per 1,000 r. Tests of 342 lethal chromosomes from 12,500 r with *y ct ras f* showed 140 cases with reduced crossing-over, of which 131 gave subsequent genetic evidence (not confirmed cytologically) of translocations in 68 cases and of inversions within the X-chromosome in 63. In the 202 lethals with normal crossing-over there were only 3 instances of the lethal effect being due to the combined effects of two separable non-lethal genes. In 19 instances at least two separable lethal genes were found in the same chromosome. Probably many of the inversion chromosomes also carried two such genes. Thus individual mutational events probably occurred at a greater than linear rate of increase with increase in dose. Similar tests with 438 lethal chromosomes from 300 r showed only 2 instances of separable lethal genes and 23 cases with reduced crossing-over of which 9 were translocations and 14 inversions. These results are comparable to those in a previously published study of lethals produced by a genetic mutator except that in that study all of the 13 analysed cases of reduced crossing-over were inversions. (This work was done under Contract No. AT(30–1)–930 of the U. S. Atomic Energy Commission.)

JAAP, R. GEORGE, and B. L. GOODMAN. Use of Diallel and Triallel Mating Systems to Estimate Non-Additive Genetic Effects in Poultry. *Ohio Agricultural Experiment Station, Department of Poultry Science, Columbus, Ohio, U.S.A.*

Within independent 2 × 2 and 3 × 3 sets of sire × dam matings the total variance from two progeny per mating has been subdivided into that contributed by the sire, by the dam and by the sire × dam interaction. These subdivisions of the variance from 25 to 160 sets were pooled for each trait and components of the mean squares used to estimate the relative magnitude of non-additive effects in both a random-bred and a growth-selected population. Data were collected for weight of body and body tissues at hatching, growth, and variation in eggs and egg production of females. Accuracy in estimating the sire, dam and interaction components of the mean squares for the population has been compared by crude estimations of their fiducial limits and, for eight-week body weight, by the similarity of duplicate samples of matings.

On a basis of an equal amount of effort being expended in data collection, the triallels appear to provide estimates superior to those obtained from diallels. For body weight at eight weeks of age 225 to 270 matings in triallel composition gave estimated fiducial intervals equivalent to those from 600 matings in diallel form. Since heritability estimates from these large numbers of matings still appeared to have fiducial intervals of about 0.7 at a 90% confidence level, a larger number of progeny per mating should aid in reducing the excessive variation observed between sets in each of the sire, dam and interaction mean square components. In the random-bred population many of the quantitative traits were observed to be influenced by relatively large amounts of non-additive gene effects. This apparent excessive incidence of non-additive gene interaction may be attributable to the recent cross-bred ancestry of the random-bred population.

JAEGER, EUTERPE C. *See* CORDEIRO, A. R., *et al.*

JAHN, ALEXANDRA H. *See* CUANY, ROBIN L., *et al.*

JAMES, A. P. *See* NEWCOMBE, H. B., *et al.*

JAMES, ALLEN P. The Frequency Distribution of Radiation-Induced Mutants Affecting a Quantitative Character in Yeast. *Atomic Energy of Canada Limited, Chalk River, Ont., Canada.*

The spectrum of individual X-ray induced mutations that affect growth rate with varying degrees of severity has been studied in an inbred strain of yeast. Mutants were detected by observing differences in the growth rates of the four haploid segregants of single diploid cells. Differences in the rates of growth were measured by comparing the rates of change in the diameters of the microcolonies from the four ascospores. The technique permits mutants to be detected where growth rates differ from those of non-mutants by only a small percentage. An exposure of 30,000 r produced recessive lethals and near-lethals (of all types) in one-quarter of the survivors. The ratio of these severe effects to the less severe but nevertheless detectable effects on growth rate (i.e., from about 90% reduction down to about 5% reduction) was approximately 1:1. The distribution of the different degrees of these non-lethal and near-lethal effects appears to be bimodal in yeast, as in *Drosophila.* A study of the dominance of the mutant genes is being undertaken.

JANICK, JULES. *See* PFAHLER, PAUL L.

JENKINS, B. CHARLES, and LAURIE E. EVANS. Some Alien Chromosome Additions to Common Wheat. *University of Manitoba, Winnipeg, Man., Canada.*

It has been suggested that the addition or substitution of chromosomes from related species may effect the transfer of germ plasm which would otherwise be impossible owing to the lack of chromosome homology between the species. Two such projects aimed at the production of whole chromosome substitutions from *Secale* and *Agropyron* to common wheat are in the advanced stages at the University of Manitoba. A preliminary step in the accomplishment of the substitutions is the production of the seven whole chromosome addition lines in the one case from Dakold winter rye to the winter hardy wheat variety Kharkov MC 22 and in the other from *Agropyron elongatum* chromosomes in the 56 chromosome derivative of the cross Chinese Spring × (Chinese Spring × *Agropyron elongatum*) F_{15} to the wheat variety Chinese Spring.

In both cases the procedure was to backcross the wheat parent to the "amphiploid" one or more times and to cytologically select monosomic and disomic addition plants in the subsequent generations. Several such 43 and 44 chromosome plants have been obtained and the extra chromosomes carried are being identified in two ways. First, the morphology of the plants is compared and gross differences are regarded as being the effects of the addition of different alien chromosomes. Secondly, the supposedly different disomic plants are diallel crossed and the cytological behavior of the extra chromosomes in the F_1 generation is used as a criterion for positive identification.

The addition lines are expected to furnish information as to the location of genes in the various chromosomes of rye and *Agropyron elongatum.* They will also be used as a means of making systematic substitutions of the alien chromosomes into the Kharkov MC 22 and Chinese Spring varieties.

JENKINS, J. A., and B. O. BERG. Inheritance of Fruit Size and Shape in the Tomato. *Department of Genetics, University of California, Berkeley, Calif., U.S.A.*

A method for dealing with the individual loci of continuously varying character differences, originally suggested by studies of carotenoid differences in tomato fruits

(Jenkins and Mackinney, 1953, 1956), was applied to a study of fruit size and shape inheritance. Subsequently, we discovered that similar procedures were outlined by Comstock and Robinson (1952) in their type III experiment for estimating the degree of dominance.

In 1949 Lindstrom's *d-p-o-s* (dwarf, peach fruit, oval fruit, compound inflorescence—linkage group I) was crossed with MacArthur's *f-a-j-lf* (fasciated fruit, green stem, jointless pedicel, leafy inflorescence—linkage group V). In addition to the two parents, the following hybrid cultures were grown in a randomized field planting in 1955: F_1, F_2, backcrosses of F_1 to both parents, an F_3 and testcrosses to both parents (three cultures) from each of 28 previously grown F_2 plants.

On a logarithmic scale segregation at the major loci *o* and *f* contributed 30% and 50% of the total additive genetic variance. The remainder was attributed to modifying genes. There was no interaction between the major loci. Each exhibited partial dominance, but in a different direction. The method of estimating average dominance outlined by Comstock and Robinson (1952) gave a more satisfactory agreement with the data than that outlined by Fisher, Immer and Tedin (1932) and elaborated by Mather (1949).

From the later generations of this hybrid we have isolated the four homozygous genotypes, *OOFF, OOff, ooFF* and *ooff*, in a relatively uniform background. When all four tester lines are crossed with a new variety, the locule number of the F_1 hybrids may be used to determine what alleles the new variety has at the *o* and *f* loci and if it has new alleles at other major loci determining variability in locule number.

JOHNSON, B. LENNART. Linkage on the S Chromosome of *Matthiola incana*. *University of California, Los Angeles, Calif., U.S.A.*

The eversporting mechanism *1S/+s* described in *Matthiola incana* consists of a chromosome carrying a pollen lethal, *1*, closely linked with the gene *S* for single flowers and of a homolog carrying *s* for double flowers. The heterozygous condition of *s* perpetuated by this mechanism results in 46 single : 54 double-flowered plants in each successive generation, the deficit of singles being due to the sublethal effects of *1* on ovules or zygotes.

Disregarding the very low *1-S* crossover frequency, linkage values between *S* and other genes have been estimated by methods using half of the F_2 phenotype classes.

Considering complete non-function of *1* pollen and a calculated viability coefficient of v = .83 for eggs or zygotes carrying *1*, the phenotype probabilities from the linked genes *S* and *W* in terms of the crossover value, p, become:

	Coupling	Repulsion
SW	$v/1+v\ (1-p+p^2)$	$v/1+v\ (1-p+p^2)$
Sw	$v/1+v\ (p-p^2)$	$v/1+v\ (p-p^2)$
sW	$1/1+v\ (2p-p^2)$	$1/1+v\ (1-p^2)$
sw	$1/1+v\ (1-2p+p^2)$	$1/1+v\ (p^2)$

from which the linkage value may be calculated by conventional methods using all of the F_2 data.

The probability of the *Sw* crossover class in coupling phase at all values of p is less than half of the *sW* class. In repulsion phase both of the *Sw* and *sw* crossover classes are small—neither one exceeding 14% of the total phenotypes at p = .50.

Although *M. incana* tends towards homozygosity, owing to nearly complete self-fertilization, the area of the *S* chromosome adjacent to *1* tends to harbor deleterious recessives in the heterozygous condition. Such recessives occurring on the *1S* homolog remain unexpressed until a crossover takes place. On the +*s* homolog they are also perpetuated but are expressed each generation in the sterile doubles. This area contains 3 recessives which affect chlorophyll or plastid production. Farther from *S* lie genes affecting flower color and plant habit.

JOHNSON, L. P. V., and RUSTEM AKSEL. Inheritance of Yielding Capacity in Barley. *Department of Plant Science, University of Alberta, Edmonton, Alta., Canada.*

The objectives are: (*a*) discovery of parental combinations that produce high-yielding progenies; (*b*) determining whether these high-yielding combinations are apparent in F_1; and (*c*) genetic analysis by biometrical techniques. Fifteen barley varieties were crossed unidirectionally in all combinations (105 crosses). The F_1 materials of a 9-parent diallel (36 crosses) were greenhouse grown in 1955–6 and the remaining material (69 crosses) in 1956–7. Each cross was represented by 40 plants (10-plant rows in 4 replications). The F_2 materials of the complete 15-parent diallel (105 crosses) were field grown in 1957, using a simple, 11 × 11 lattice (4 replications). Each plot consisted of four 16½-foot rows.

Yields of F_1 and corresponding F_2 populations gave correlation coefficients of $r = +0.4815^{**}$ for 36 crosses or $r = +0.2735^{**}$ for 105 crosses. The genetic analyses of the 36 crosses + 9 parents showed (*a*) dominance present but (*b*) not unidirectional, and (*c*) significant asymmetry at loci exhibiting dominance. Although the heterogeneity of Wr-Vr was not significant (error value was rather high), analysis of the (Vr, Wr) graph suggests possible non-allelic gene interactions; genotypic-environmental interaction is probably also present. All Vr, Wr points were below the line of unit slope through the origin; the actual Wr/Vr regression line is less than unity and not significant. The general picture is one of over-dominance.

Analytical results of the F_2 (105 crosses + 15 parents) are roughly similar to those of F_1. The heterogeneity of Wr-Vr is nearly significant at the 0.05 level. The averages of the Wr/Vr points lie below the line of unit slope through the origin: i.e., the F_2 data also show over-dominance.

JUCCI, CARLO. Physiogenetic Researches on Heterosis in Silkworms (*Bombyx mori*). *Centre of Genetics, National Research Council, Istituto "L. Spallanzani," Università, Pavia, Italy.*

The investigation of heterosis in domestic animals, such as silkworms, may have interesting results not only for breeding—more efficient utilization of hybrid vigour—but also for theory, leading to: (1) a deeper physiogenetic understanding of interactions between alleles of the same locus and alleles of different loci—exploring overdominance and complementary effects; and (2) a more adequate factorial analysis of processes both for adding beneficial effects of dominant genes and for buffering unfavourable effects of recessive genes.

Study of the phenotypic expression of heterosis such as increase in resistance, aspecific and polyvalent, and increase in fertility—the best advantage of hybrid vigour in double hybrid Japanese silkworms, as in double hybrid American maize—is interesting also for a better understanding of the role of heterosis in nature.

In nature gains in resistance—to unfavourable, biotic and physical, environmental conditions—and in fertility contribute most efficiently to the superiority of the heterozygote and influence, through it, genetic structure of populations, breeding system and evolutionary pattern.

Besides resistance and fertility, the following items have been investigated in order to clarify the physiological aspects of hybrid vigour: (1) intraovular and larval development in F_1 hybrids studied as weight growth and oxygen consumption; (2) silk gland's growth and secretion in F_1 hybrids and respiratory activities of the glandular epithelium; (3) resistance of F_1 hybrids to DDT and other chlorinated insecticides.

The comparison with parental breeds has been effected in couples of reciprocal hybrids, so as to allow the study of maternal prevalence in the earlier stages of development and to discover cytoplasmic factors of heterosis if any coexist with chromosomic ones.

For a better analysis of the heterosis effect some of the F_1 hybrids have been compared with parental breeds in series of families having, two by two, the same father and different mothers.

Judd, B. H. An Analysis of the Subdivisions of the White Region in *Drosophila melanogaster. University of Texas, Austin, Texas, U.S.A.*

The spatial relationships of several of the mutants of the pseudoallelic white series in *Drosophila melanogaster* have been examined. There are at least three separate loci which may be distinguished. They may be represented by the mutants Brownex (w^{Bwx}), apricot (w^a) and white-1 (w^1), located from left to right in the order named.

Some mutants of the series cannot be located with certainty in relation to these three loci. The mutant blood (w^{bl}), for example, will not recombine with either w^{Bwx} or w^a but apparently is located to the left of eosin (w^e), which in turn appears to be at the w^1 locus. The mutant buff (w^{bf}) recombines with w^{Bwx}, w^a and w^e but cannot be located exactly because of the appearance of recombinant classes which contradict an assignment to a specific locus (e.g., from y^2 w^a *spl ec*/w^{bf} females, the exceptional crossover types are *w spl ec* and y^2 *w*). Such results may indicate that w^{bf} occupies a fourth locus in the region.

From some heterozygous combinations different exceptional types result from crossovers in the same direction; for example, w^+ *spl ec* and *w spl ec* types are recovered from y^2 w^{Bwx} *spl ec*/w^h females. In this and similar cases it has been found that the crossover class of white phenotype is not the double mutant.

The spatial relationships of the pseudoallelic loci and the origin of some of the recombinant classes will be discussed.

Jugenheimer, Robert W. Performance, Uniformity, and Practicability of Various Types of Corn Hybrids. *University of Illinois, Urbana, Ill., U.S.A.*

The balanced nature of this experiment permitted studying the relative performance and uniformity of plant and ear characteristics of various types of corn hybrids.

Four inbred lines of corn, Hy, L317, WF9, and 38-11, were combined in all-possible combinations to produce 6 single crosses, 12 three-way crosses, 12 single-backcrosses, 12 backcrosses, 3 double crosses, and 6 top crosses. The theoretically homozygous inbred lines were more variable than the hybrids in ear weight, ear length, and ear height, traits greatly influenced by the environment. The inbred lines were very uniform in number of kernel rows, a trait determined primarily by genetic factors and affected very little by the environment. Highest yields and greatest uniformity were obtained from the single cross, three-way cross, single-backcross, and backcross hybrids.

Single cross hybrids were slightly higher yielding and more uniform than other types of hybrids. The relatively high cost of producing seed of single crosses limits their use to situations where extreme uniformity is important. Double crosses (the most widely grown type of hybrid) and top crosses were considerably lower yielding and more variable in plant and ear traits than the other types of hybrids. Of the 12 single-backcross hybrids 8 yielded more grain than the best double cross. The best single-backcross hybrid yielded 9 bushels (nearly 10%) more than the best double cross hybrid.

Seedsmen are interested in hybrids with greater uniformity and performance than presently used double cross hybrids. Single-backcross hybrids appear to offer commerical utilization. They produce higher grain yields, contribute greater uniformity of plant and ear, and are practical to produce, inasmuch as the seed is grown on a vigorous single-cross parent.

KÄFER, ETTA. Analysis of a Translocation by Means of Mitotic Recombination in *Aspergillus nidulans*. *Department of Genetics, McGill University, Montreal, Canada.*

After ultraviolet irradiation of a standard biotinless (*bi*) strain of the fungus *Aspergillus nidulans* a cholineless (*cho*) mutant was isolated. In the course of mitotic localization of this mutant, it became evident, that the new *cho bi* strain carried a chromosomal aberration involving linkage groups I and VII. Mitotic haploidization in diploid fungus strains produces segregants which are recombinant for whole chromosomes, that is, similarly to results obtained by the *Drosophila* inversion technique, markers of the same chromosome show complete linkage.

The mutant *cho* was crossed to standard strains with various markers of linkage groups I and VII and meiotic recombinants were then tested by means of mitotic haploidization. The original *cho bi* strain and some of these meiotic recombinants showed complete linkage of all markers of linkage group I with those of linkage group VII in mitotic haploids, while others showed normal linkage of only the markers within each group. In analogy to similar findings in *Drosophila* it was concluded, that a translocation between the two chromosomes is present in the original *cho bi* strain, which can be separated from *cho* by meiotic crossing over. Very close linkage (4% crossing over) of the translocated piece to the most distal marker on the left arm of linkage group I (a suppressor of adenine-20) was found and results from mitotic crossing over confirmed, that a substantial chromosome piece of linkage group VII is attached in this position. Whether this is a case of a reciprocal translocation and what the exact size of the translocated piece(s) is, cannot be decided, as both available markers of linkage group VII show practically

50% recombination with the translocation. New markers in suitable positions and cytological analysis may give further information on these points.

KÁLLAY, I. *See* GYÖRFFY, B.

KALTER, H. Studies on the Inheritance of Susceptibility to Congenital Malformations Produced by Maternal Riboflavin Deficiency in Mice. *Children's Hospital Research Foundation, Cincinnati, Ohio, U.S.A.*

Intra- and inter-strain crosses were made with members of several inbred mouse strains. (Results from various backcrosses now being made may also be presented.) At 9⅓ days after conception, females were given for 4 days a riboflavin-antagonist, galactoflavin, incorporated into a riboflavin-deficient diet. Young were removed before term and examined grossly and histologically for congenital malformations.

Numerous skeletal, encephalic, and esophageal malformations occurred in offspring of intra-strain crosses (in whom a survey of effects of riboflavin deficiency on embryonic development was made). Young from inter-strain crosses were scored for several malformations only—cleft palate, syndactyly, ulnar abduction of hand, absent esophagus, and brain anomalies.

Surprising results ensued from a study of frequencies of these malformations in F_1 offspring as related to frequencies in parent strains. In general, it appeared that (1) where frequencies in parent strains were relatively high and not statistically different from each other, F_1 frequencies were greatly lower than those of the parent strains; and (2) where the parent strains were different, one having high, the other low frequency, the F_1's had frequencies on the order of that of the resistant parent strains. The first finding reveals the stabilizing power of hybridity and the second partly indicates the dominance of factors responsible for resistance.

KAMRA, OM P., and R. A. NILAN. Anatomy of the Multiovary Mutant in Barley. *State College of Washington, Pullman, Wash., U.S.A.*

The multiovary (*mo*) mutant of barley is characterized by the transformation of stamens into pistils. It was induced by irradiation and behaves as a simple recessive (Moh and Nilan, J. Hered. *54*: 183–188). The present paper is a report of a study of the anatomy and the embryo sac development of the mutant florets.

The transformation of stamens into pistils appears to take place very early in the floret development. It is complete in most florets, whereas it is only partially complete in the remainder.

A floret of normal barley has two lodicules. In the mutant plant, however, the florets of median spikelets have one lodicule and those of the lateral spikelets have two. In general, the mutant florets appear to contain more vascular tissue than normal florets.

The embryo sac appears to be normal (the Polygonum type) with six antipodals. A frequent abnormality is the formation of a T-shaped tetrad instead of a linear tetrad. Ovules of the mutant florets are naked or enclosed, while those of normal barley are always enclosed.

Since the mutant florets are variable as to the degree of transformation of stamens, number of lodicules, and covering of the ovule, it is concluded that the gene *mo* has a low expressivity.

Further studies of this mutant should be valuable for an understanding of sex determination and sex reversal in higher plants.

KANEHISA, TAKEHARU. A Study of Some Metals in "Melanotic Tumor" Strains of *Drosophila*. *Osborn Zoological Laboratory, Yale University, New Haven, Conn., U.S.A.*

Genetic and physiological studies have shown that the character "melanotic tumor" (*tu*) in *Drosophila* is intimately related to a tryptophane metabolic pathway (Kanehisa, 1954, 1955, 1956, 1957). The present investigation deals with the probable relationships of some metals to tumor formation, tryptophane metabolism and melanization. Eggs of the strains *tu*, *bw tu*, *v tu*, *tu st*, ±, *bw*, *v*, and *st* were placed on the synthetic medium of Sang, with some variation, and pupae were analysed for Fe, Cu, Co, Ni and Mo content by the methods of Sandell and Kikkawa, with some technical improvements. Viability and incidence of melanotic tumor were also studied. Results may be summarized as follows: (1) the amounts of Cu, Fe and Co accumulated in pupae are relatively lower in *tu*-strains than in non-*tu*-strains; (2) the amounts of Fe and Co are higher in *tu* and *bw tu* pupae than in *tu*-strains containing gene related to tryptophane metabolism, although the reverse relationship holds for the amounts of Cu present; (3) Viability of *tu*-strains is relatively lower than that of non-*tu*-strains; (4) Incidence of melanotic tumors and viability of *tu*-strains are higher in *tu*-strains which contain gene related to tryptophane metabolism than in *tu*-strains without such gene. The relationships of tryptophane metabolic pathway, tumor metabolism and melanin formation will be discussed in the light of present results and the data previously published.

KANEHISA, T., and D. F. POULSON. Nucleo-Cytoplasmic Interaction in the Control of Metal Accumulation in Two Strains of *Drosophila melanogaster* and Their Heterozygotes. *Department of Zoology, Yale University, New Haven, Conn., U.S.A.*

Advances in knowledge of metal metabolism together with evidence for its genetic control in *Drosophila* (Poulson and Bowen, Exp. Cell Res., Suppl., 2: 161–180; Poulson *et al.*, Proc. Nat. Acad. Sci. *38*: 912–921; Poulson, Genetics *40*: 590; Kikkawa, *et al.*, Science *121*: 43–47) have focused our attention on the responses of the *ebony* series of alleles to the level of copper in the medium on which the larvae are raised. Striking differences in the survival of *ebony*^{11} as compared with *ebony* and *Oregon R* strains led to a combined study of metal accumulation and survival in *ebony*^{11}, *Oregon R*, and their heterozygotes at different levels of copper in the medium.

To simplify the nutritional situation the experiments were carried through on Sang's (J. Exp. Biol. *33*: 45–72) chemically defined medium under aseptic conditions. Two levels of iron and three levels of copper were employed. In each creamer 50 eggs were placed on 5 ml. of medium and maintained at 25°C and nearly 100% humidity to prevent evaporation. Comparisons were made between homozygotes (e^{11}/e^{11} and $\pm/\pm$) and both types of heterozygotes ($e^{11}/\pm$ and $\pm/e^{11}$). Survival was measured as the percentage adult emergence. Copper, iron, nickel, cobalt, and molybdenum were determined analytically using standard procedures on samples of 150–200 pupae.

The survival data are in agreement with those on standard medium with live yeast although on the defined medium the levels of survival are lower for the toxicity threshold is also lower. While there is some survival of wild type and heterozygotes on the standard medium up to 300 μg. Cu/g., a concentration of 100 μg. Cu/g. in the defined medium is toxic to all 4 genotypes. The order of survival is the same on the defined medium with 60 μg. Cu/g. and on standard medium with 100 μg. Cu/g., e.g., $\pm/\pm > e^{11}/\pm > \pm/e^{11} > e^{11}/e^{11}$.

Metal analyses gave these interesting results. Cu accumulation is significantly higher in e^{11}/e^{11} than in $\pm/\pm$ larvae at the three Cu levels employed. There are even larger differences between the two types of heterozygotes which also differ from the homozygotes. There are striking differences in Fe content of larvae among the different genotypes at different Cu levels: $\pm/\pm$ larvae contain nearly twice as much Fe as e^{11}/e^{11} on medium with no added Cu, but drop to very low levels at higher Cu concentrations while e^{11}/e^{11} show a marked increase in Fe. With no added Cu $\pm/e^{11}$ larvae accumulate twice as much Fe as $\pm/\pm$ and three times as much as e^{11}/e^{11}. At higher Cu concentrations the Fe content of $\pm/e^{11}$ drops off, but is still high in relation to $\pm/\pm$. With no added Cu $e^{11}/\pm$ larvae have the same Fe content as e^{11}/e^{11}, but with added Cu this falls off, paralleling $\pm/\pm$. When the Fe concentration in the medium is halved the differences among the genotypes with regard to both Fe and Cu accumulations are much less marked and the survival of e^{11}/e^{11} is further lowered in relation to other genotypes. Analyses for Ni, Co, and Mo were also made in one experiment. There appeared to be no significant change in Ni content with higher Cu concentrations, although there was an increase in Mo content in all genotypes and a decline in Co content.

The differences in patterns of Cu and Fe accumulation between the two types of heterozygotes provide an excellent example of nucleo-cytoplasmic interaction and are being investigated further from this point of view.

(Work supported by a grant from the National Science Foundation.)

KANG, YUNG SUN. A Study of Korean Population Genetics: Vital Statistics of Different Occupational Groups in the Korean Population. *Seoul National University, Seoul, Korea.*

Data have been obtained on the vital statistics which are correlated with population genetics for a Korean population of 220,456 who are resident in several areas.

For 2 years, from 1955 to 1957, measurements were made of the variations of the following factors. Birth rate of the Korean population is 16.31 per 1,000, in general, but among those engaged in heavy labour, this is higher, 18.86, as is commonly found in most populations.

It is well known that the Korean population has the highest sex ratio at birth compared with other populations. The ratio found here is 113.92 males per 100 females.

The death rate is slightly lower than the birth rate, 14.73 per 1,000. Comparing the rate of the group engaged in mental work with that of the group engaged in physical work, scarcely any difference could be found between the two groups.

In this research, 318 pairs of twins were recorded. Of these 66.7% were monozygous twins, and their sex ratio was higher than the rest of the population: 126.33 males per 100 females. The proportion of sexual combination is ♂♂ 2.85: ♂♀ 1.00: ♀♀ 2.16.

From 1953 to 1956, the author studied 1,364 marriages which included 65 cousin marriages. The frequency of cousin marriages is thus 4.76%.

Kaplan, William D. The Sterility Component of X-Ray Induced Dominant Lethals in *Drosophila melanogaster*. *City of Hope Medical Center, Duarte, Calif., U.S.A.*

In *Drosophila melanogaster* dominant lethals are determined by egg hatchability tests. Brooding techniques, the mating of treated and control males to a succession of virgin females, permit the determination of mutation rates in sperm that were successively younger at the time of irradiation. However, *Drosophila* offers no direct way to distinguish between eggs that have failed to hatch because they remained unfertilized and eggs that have failed to hatch because development of the embryo has broken down as a result of an induced genetic event. For this reason Kaplan, Tanaka and Tanaka (Rec. Gen. Soc. Amer. *25*: 649) carried out a preliminary parallel genetic and cytological study. A sample of eggs from each dominant lethal determination was fixed and sectioned and studied for evidence of sperm entrance. It was found that unfertilized eggs contribute significantly to the dominant lethality rate based upon hatchability tests. The present report presents data on sterility obtained when the X-ray dosage and the mating intensity (number of females per male) are varied. Three X-ray dosage levels, 500, 1,500 and 2,500 r units, were used. At each dosage level three broods each of one female per male, two females per male, and three females per male were carried out. Each male was permitted to mate over a period of nine days, three days per brood.

The data show that sterility (failure of sperm to enter an individual egg) increases with dosage and is highest in the third brood; but brooding itself is no cause of sterility. The high sterility observed in the treated third brood fertilizations (sperm that were spermatocytes or younger at time of irradiation) seems to be a combination of factors produced by the radiation and the utilization of sperm.

Katsuo, Kiyoshi. *See* Mizushima, Usaburo.

Kaudewitz, Fritz. A New Type of Mutation-Delay in Bacteria. *Max-Planck-Institut für Virusforschung, Tübingen, Germany.*

UV-irradiated cells of *Salmonella typhimurium*, auxotrophic strain lys-1, give rise to prototrophic "reversions." Three hours after plating the non-mutated cells start logarithmic growth. As demonstrated by respreading, the number of potentially mutated cells per plate, however, remains constant up to 5 hours and 40 minutes after. This delay could be due to (*a*) a prolonged lag phase of mutants, (*b*) segregation of several nuclei per cell or homologous genetic subunits per nucleus, only one of which is mutated, (*c*) the formation of filaments, or (*d*) the linear transfer of the character "potentially mutated." Negative experimental evidence favours (*d*). Between 0 and 5^{40} or 3 and 5^{40} respectively penicillin kills non-mutated and potentially mutated cells with the same efficiency, thus excluding (*a*). Cells washed off the plates at 5 hours are separated by centrifugation and filtration into fractions, all of which have the same ratio of mutant/non-mutant cells, thus excluding (*c*). Higher levels of lysin in the minimal medium between 3 and 5^{40} increase the number of generations from ¾ to 4½. The increase of mutated cells however unchanged starts at 5^{40}, thus excluding (*b*).

The genetic manifestation of the "reversion" is highly temperature-sensitive: temperatures of 34°C and lower give 100% yield of mutants which is gradually decreased to 0% by increasing the temperature to 36.5°. Various lys-1 "reversions" usually differ in colony size. The prototrophic character of only about 10% is transducable to lys-1 cells. Transduction analysis proves them to be due to suppressors. X-ray radiation of transducing phages being synthesized in transducable reversions reveals that the target size of the genetic material causing the prototrophic character varies greatly in different "reversions" and is bigger than a gene locus.

The same degree of temperature sensitivity of genetic manifestation, rare transducability and delayed increase in number is shown by spontaneously arising lys-1 "reversions" and was found in the reversions of 11 from 90 auxotrophic mutants of *Salmonella typhimurium* and *Escherichia coli* (no transduction analysis), thus demonstrating the generalisation of the phenomenon.

Experimental data are in agreement with the following working hypothesis. By the mutational event part of the genetic material is separated from the linkage group. Having lost its reproducibility it is transferred for some time linearly. Its reincorporation may lead to a variety of rearrangements which, as nongenic suppressors, cause quantitatively different prototrophic characters. Most of these rearrangements are too large in size to be transducable.

KEEP, ELIZABETH. *See* KNIGHT, R. L.

KHITRINSKY, V. Controlled Heredity Changes Aimed at Transforming Spring Varieties into Winter Crops Seen as a Plant-Breeding Method. *Genetics Department, All-Union Genetics and Plant-Growing Institute, Odessa, U.S.S.R.*

Seeds of several varieties of spring wheat, previously checked for genetic homogeneity were sown in the open in the pre-winter period (from late November to December). The generations to follow were sown at about the usual time of winter wheat sowing in the given region (September).

Under conditions of autumn sowing spring wheat varieties (Lutescens 1163, Odesskaya 13, Milturum 274) underwent several changes in morphology. These included the creeping type of stem typical of winter varieties instead of the usual erect type, a decrease in length and spiral twisting of the leaves and an increase in the number of plants with glabrous leaves. These changes were hereditary and were preserved in the progeny with considerable stability. Physiological characteristics affected by autumn sowing included an increase in the dry matter content, an increase in the sugar percentage, an increase in the water retaining capacity and a lengthening of the vernalization stage. These changes also proved to be hereditary and preserved with great stability in the second generation.

The modified strains of rye and wheat yielded an increased number of frost-resistant plants with winter crop characteristics according to the quality and quantity of assimilated light. The greatest number of such plants was developed in the groups which were given additional night lighting with incandescent lamps.

Modified Odesskaya 3 wheat showed a changed total time of ear formation. Experiments were also undertaken to assess resistance to brown rust and stinking smut of modified strains. Grain yield for the modified strains was generally below that of the standards, although in certain strains it was increased. Most of the lines of modified wheat possess high qualities of grain, flour and bread.

The method of controlled heredity changes aimed at transforming spring varieties into winter crops has been worked out to a degree when it can be successfully used in practical plant-breeding.

KIDWELL, J. F., and H. J. WEETH. The Effect of Nutritional Environment on Selection for 70-day Body Weight in the Laboratory Rat. *University of Nevada, Reno, Nev., U.S.A.*

Four inbred lines of laboratory rats were used to form a four-way cross. Four lines, consisting of 10 males and 10 females each, were randomly established from this cross. Two of the lines were maintained on a standard laboratory ration and two on a ration consisting of 35% ground alfalfa and 65% standard laboratory ration. One line on each nutritional regimen was selected for 70-day body weight and the other selected at random. Random mating was practised in all lines, except that full sib matings were prohibited. Each litter was reduced to 6 at 5 days, with an attempt to retain 3 males and 3 females. Most litters contained 6 individuals; there was none with less than 4. Litters were weaned at 28 days and maintained on the test ration until 70 days. Selected individuals of all lines were put on the standard ration at 70 days. Females were bred at 100 days and produced only one litter. This paper summarizes the results of the first 5 generations. The data consist of 28- and 70-day body weights. The four-way cross generation is designated as the zeroth generation; the next as the first selected generation, etc.

In all lines both 28- and 70-day weight decreased during the first and second selected generations. In the selected lines selection differentials were positive and significant. In the random lines there were no significant differences between the mean of the entire generation and the parents of the next generation. In the third, fourth and fifth generations a positive selection response was observed. The selected line on the standard rations has surpassed the four-way cross while the selected line on the roughage ration is at the level of the four-way cross. The random lines have remained at about the level of the first selected generation. These observations suggest heterosis in the four-way cross, probably as a result of favorable epistatic combinations. They also suggest that as favorable epistatic combinations are broken up in successive generations there is an increasing effect of genes that act in an additive fashion.

Heritability estimates have been computed by three methods: regression of offspring on midparent, regression of offspring on parent, and correlation between full sibs. The estimates are quite erratic and do not reflect actual selection response. Small sample size may be invoked as an explanation but is hardly adequate. A completely satisfactory solution is not immediately apparent.

KIHARA, H., K. YAMASHITA, and M. TANAKA. Some Aspects of the Genomes of 6*x* Species in *Aegilops. Biological Laboratory, Kyoto University, Kyoto, Japan.*

A classification of the genus *Aegilops* by means of genome-analysis was published in 1954 (Cytologia *19*). At that time the study of the 6*x* species, *Ae. triaristata, Ae. crassa* and *Ae. juvenalis,* was still incomplete. Recently, we have obtained enough data on the basis of the morphological as well as genome-analytical analyses to draw the conclusion that the third genome of the hexaploid *Ae. triaristata* is a modified M and that of *Ae. crassa* is D. The genome-type of *Ae. juvenalis* was also ascertained as $DDC^{u}C\ {}^{u}M^{j}\ M^{j}$.

KIKKAWA, H. Genetic Analyses of the Resistance to Parathion in *Drosophila melanogaster. Department of Genetics, Faculty of Medicine, Osaka University, Osaka, Japan.*

Genetic studies on the resistance to chlor-organic insecticides such as DDT and BHC have been performed extensively throughout the world, whereas studies on organic phosphorous insecticides have been few and incomplete. The test method adopted here was mainly the "larval test." A certain number of late first instar larvae (50–100) were transferred to the medium containing parathion, and the rate of emergence was studied. Very similar results were obtained by the "adult test." The results of the genetic analyses are as follows: (1) The resistance to parathion is mainly controlled by a dominant gene locating near 64.5 on the second chromosome. Any susceptible second chromosome which received the portion involving this dominant gene by means of double crossing-over shows the resistance not only to parathion but to other insecticides such as DDT and BHC. Therefore, this may be the same or pseudoallelic with that of resistance to DDT and BHC reported by Tsukamoto and Ogaki. (2) In addition to this major gene, the parathion-resistance is also controlled by a dominant gene locating near 50 on the third chromosome. But the effect of the third chromosome is very weak. The gene may be identical with that for nicotine-resistance. Furthermore, where two strains differing extremely in resistance are used, an effect of a sex-linked gene is recognized under certain condition. (3) Of great interest is the fact that in a high parathion concentration, a phenomenon of maternal effect is clearly observed. Moreover, some interesting facts in relation to parathion-resistance were found by my co-workers, and will be reported.

KIMBALL, ROBERT F. The Postirradiation Period and Mutation in *Paramecium. Biology Division, Oak Ridge National Laboratory, Oak Ridge, Tenn., U.S.A.*

Since the process by which radiation produces recessive lethal mutations in *Paramecium* is relatively slow, it can be modified by treatment after irradiation. The hypothesis has been advanced that the mutational process is spontaneously reversible when initiated during the first half of the interdivision interval but is irrevocably completed at about the middle of the interval. Procedures that retard growth, provided that they do not interfere with the reversal of mutation itself, should decrease mutation by allowing extra time for reversal.

The present paper points out the variety of apparently unrelated features of mutation in *Paramecium* that can be understood with this hypothesis. First, the diversity of procedures that decrease mutation is explained; all slow growth and need have nothing else in common. Secondly, the increase in apparent sensitivity during the first half of the interval is explained; there is more time for recovery when radiation is given early. Thirdly, several differences between X-rays and ultraviolet become understandable. Ultraviolet markedly slows growth in the dose range used; X-rays do not. Therefore ultraviolet probably acts both as a mutagen and a "recovery" agent, whereas X-rays act as a mutagen only. Fourthly, prolonged starvation before irradiation decreases the amount of mutation produced by X-rays; this is most easily explained by the effect of starvation on growth after irradiation.

Work with a number of organisms has established that mutational change, in the broad sense, is often a relatively slow process that can be influenced in a variety of ways after irradiation. The work with *Paramecium* suggests the importance of this fact in understanding various features of the mutational process and emphasizes the important influence that effects on cell growth may have.

KING, ROBERT C. *See* BENDER, HARVEY A.

KLOEPFER, H. WARNER. Progress Report on Study of a Type of Progressive Juvenile Dementia with Oligophrenia and Erythema. *Department of Anatomy, Tulane University, New Orleans, Louisiana, U.S.A.*

Seven cases (4 males and 3 females) of progressive juvenile dementia with oligophrenia and erythema occurred among 22 offspring in 4 families. The 8 parents are first or second cousins with a common ancestor. Inheritance is by an autosomal recessive gene with 100% penetrance. This syndrome is being studied from the standpoint of neuropathology, neurology, dermatology, biochemistry, and ophthalmology.

Each affected individual is believed to be normal until one or two months of age when severe blistering occurs from exposure to sunlight. Erythema gradually subsides by the age of 5 or 6 years when growth (measured by stature and weight) ceases uniformly in all parts of the body. Mental age does not progress beyond the level of an imbecile. Immediately after or during a normal adolescence progressive degenerative dementia accompanied by a loss of vision sets in which lasts until death occurs between the ages of 20 and 31. For several months prior to death patients are completely blind, deaf, and bedfast idiots.

The various stigmata in each case seem to be expressed in a very similar manner and at a similar age. This syndrome does not seem to have been described previously. In a preliminary neuropathological report on one patient John Moossy, (neuropathologist, Louisiana State University School of Medicine) states: "In the limited material available there is severe brain damage consisting of loss of nerve cells in the cerebral cortex and other areas, widespread ferrugination of cortical capillaries and capillaries within the putamen, large areas of subcortical demyelination with astrogliosis, alterations in the dentate nucleus of the cerebellum and gliosis in the cerebellar white matter, and excessive accumulations of lipochrome probably representing some degree of pigmentary degeneration in the nerve cells of the medulla, pons, dentate nucleus of the cerebellum and some areas of cerebral cortex."

KLOEPFER, H. WARNER. *See* WATT, DEAN D.

KNIGHT, R. L., ELIZABETH KEEP, and J. B. BRIGGS. Resistance in the Red Raspberry to *Amphorophora rubi* (Kalt.). *East Malling Research Station, East Malling, England.*

Breeding against raspberry viruses at East Malling is concentrated mainly on vector resistance, since several of the numerous viruses that attack the raspberry in Great Britain are carried by the aphid *Amphorophora rubi*. The resistance of the variety Baumforth A to *Amphorophora* is controlled by a single dominant gene A_1, which is linked with the normal allele of a semi-lethal gene, *fr*. The cross-over value of these two loci is approximately 3.3%. The gene A_1 confers high resistance both to seedling plants in the insectary and to mature plants in the field.

In the course of the work, evidence for the existence of hitherto undescribed biologic races of the aphid was obtained, only one of which was partially successful in colonising A_1 plants. A source of resistance to this race has been found.

KNIGHT, ROBERT J., Jr. The Adaptive Significance of Variation in Response to Dark Period in *Ipomoea*. *Blandy Experimental Farm, University of Virginia, Boyce, Va., U.S.A.*

Four species of *Ipomoea* and one artificially produced amphiploid, assembled from a number of locations at differing latitudes in the Northern Hemisphere, were grown in northern Virginia, at 39° north latitude, under conditions of natural day-length. In the short days of winter or of early spring or the shortening days of midsummer, those from the northernmost sources began blooming before those originating farther south. There was a trend of declining sensitivity to lengthening nights, demonstrated by a tendency to remain longer in vegetative growth, as parent stocks originated at lower latitudes. Hybrids between "long-day" and "short-day" taxa in two species appeared to demonstrate the genetic dominance of "short-day" to "long-day" bloom response. A small F_2 population appeared to show segregation for flowering behaviour when grown in an artificially maintained dark period of ten hours. In *Ipomoea*, populations which have invaded relatively high latitudes, or have been cultivated at northerly latitudes as annuals propagated from seed, initiate bloom under shorter dark periods—longer day-lengths—than do populations of the same species derived from locations nearer the equator. Genetic dominance of the "short-day" plant and the subsequent appearance and selection (either natural or artificial) of "long-day" genotypes are considered to be factors of evolutionary significance in adapting the species to occupy higher latitudes.

KNOTT, D. R. The Effect on Wheat of an *Agropyron* Chromosome Carrying Rust Resistance. *Field Husbandry Department, University of Saskatchewan, Saskatoon, Sask., Canada.*

A stem and leaf rust resistant derivative produced by L. H. Shebeski from the cross, *Triticum vulgare* Vill. var. Chinese × (Chinese × *Agropyron elongatum* (Host) Beauv.), was one of the parents in the present study. Cytological studies of F_{13} plants showed that some of them had 56 chromosomes although plants with other numbers also occurred. At meiosis in most cells all of the chromosomes formed bivalents. However, configurations including one or two multivalents were not uncommon. The F_{13} plants were crossed and backcrossed repeatedly to *Triticum vulgare* var. Thatcher, using stem rust resistant progeny as the non-recurrent parents in each generation. The F_1 plants from the cross with Thatcher usually had 49 chromosomes and at meiosis multivalents were frequent although some cells had 21^{II} and 7^{I}. As the backcrossing progressed, rust resistant plants carrying a single *Agropyron* chromosome were produced. The added chromosome never appeared to pair with a wheat chromosome.

After the second and later backcrosses to Thatcher, the rust resistant plants in the progeny were selfed and homozygous resitant lines obtained. These lines proved to be either substitution lines in which a pair of *Agropyron* choromosomes had replaced a wheat pair, or addition lines in which the *Agropyron* pair had been added to the wheat complement. Monosomic analysis revealed that two of the substitution lines lacked chromosome VI. The substitution lines showed normal vigor and fertility and some yielded equally as well as Thatcher. The addition lines, however, were later and somewhat less vigorous.

Gametic transmission of the *Agropyron* chromosome was studied in plants having $21^{II} + 1^{I}$ (*Agropyron*) and also in plants having $20^{II} + 1^{I}$ (wheat) + 1^{I} (*Agropyron*). The *Agropyron* chromosome had no deleterious effect on the gametes and was transmitted with equal frequency through both eggs and the pollen. Gametes carrying 20 wheat chromosomes and 1 *Agropyron* chromosome appeared to have a slight competitive advantage over gametes carrying 21 wheat chromosomes.

KOBAYASHI, TEISAKU. Radiation-Induced Mutant Types in Sesame. *Biological Institute, Toyama University, Toyama, Japan.*

Three different forms of sesame (*Sesamum indicim* L.) cultivated in Japan, B_1D(BAN-type), WD(3BO-type), and WD_8(QAN-type), were treated with four different radiations (β-ray from P^{32}, X-ray, γ-ray from Co^{60}, and β-ray + X-ray). During a period of three years, various visible mutant types were obtained from the treated generations and their progenies. The effects of the radiations on the external characters of sesame plant were shown by three major changes: (1) alteration of phyllotaxis, (2) development of nectary to functional flower or capsule, and (3) increase of loculus number per capsule.

B_1D(BAN-type) was more affected by the three changes due to radiations than were the other types; in consequence, a considerable number of mutant types were obtained from the B_1D(BAN-type). Among the mutants from B_1D(BAN-type), there were also types similar to the mutant types derived from WD(3BO-type) and WD_8(QAN-type). This finding suggests that B_1D(BAN-type) may be an ancestral type of the sesame cultivated in Japan, and that WD(BAN-type) and WD_8(QAN-type) may have originated from a B_1D(BAN-type)-like form.

KOCH, GERHARD. Genetics of Microcephaly in Man. *Institut für Humangenetik der Universität Münster/Westf., Germany.*

Owing to the initiative of Prof. v. Verschuer, an extensive registration of pathological traits and syndromes in man (considered to be caused by mutant genes) was started in April 1957, in a population of more than two million people, to supply data for studies in population genetics.

One of the conditions being investigated is microcephaly. From April 1957 to March 1958, 83 index cases of this disease were found through systematic search in mental hospitals. Our sample of microcephalics must be divided into two groups: hereditary and non-hereditary. Some probands died during the early period of life (i.e., within the first days or within a few months of birth). On the basis of our observations, the etiology of microcephaly cannot be explained by such circumstances as age of the mother at birth of the child, birth rank of the patient, and other secondary factors. Family studies revealed that the sibship of several index cases included additional cases affected with microcephaly. Consanguineous marriage of the parents of our probands was found in a few of the families. As yet, our material on microcephalics includes a series of three twin pairs discordant as to microcephaly. Individuals showing a minor degree of microcephaly could be considered to be heterozygotes with regard to the pathological gene. Moreover, the question of a heterogenic basis for this trait is considered. From the data of other authors as well as from our own it can be concluded, however, that the great majority of microcephalics are the result of a single-factor inheritance, namely an autosomal recessive gene.

KODANI, MASUO, and SABRO KANAI. The Karyosomal Chromosome of Man. *State University of Iowa, Iowa City, Iowa, U.S.A.,* and *Shida Hospital, Shiguokaken, Japan.*

The chromosome bearing the karyosome in man has been analyzed for the structure of the chromosome and of the karyosome as well as for the structural relationship of the two. The karyosome is found to be associated with relatively large and highly Feulgen positive "basal chromomeres" at early primary spermatocyte prophase. Under certain conditions the karyosome may be pushed away or removed completely from the "basal chromomeres" without disrupting the structure of the chromosome. Thus the karyosome does not appear to be an integral part of the linear structural continuity of the chromosome. The structure of the chromosome and of the associated karyosome will be described.

KOJIMA, KEN-ICHI, and C. CLARK COCKERHAM. Stability of Equilibrium when Selecting for Genes which Exhibit Epistasis. *North Carolina State College, Raleigh, N.C., U.S.A.*

A random mating population with two alleles at each locus, with free recombination between loci, and with interactions between non-allelic genes is considered. The necessary and sufficient conditions for mass selection to be ineffective and for the equilibrium to be stable are (1) overdominance for the marginal means of each locus when at equilibrium; (2) the matrix of which the diagonal elements are the dominance comparisons and the off-diagonal elements are twice the additive × additive comparisons is negative definite when at equilibrium. When these conditions are satisfied, fitness is at a relative maximum. Specific examples for two loci and for more loci when the effects of the loci are equal are considered.

KØLMARK, G. *See* DESERRES, F. J.

KOO, FRANCIS K. S. Induction of Somatic Mutations in a Balanced Lethal Barley Stock by X-Rays. *Department of Agronomy and Plant Genetics, University of Minnesota, St. Paul, Minn., U.S.A.*

Seed lots of a balanced lethal barley stock heterozygous for albino (a_n) and xantha (x_c) were exposed to 100 kv. unfiltered X-rays from a constant potential source. After treatment seeds were immediately hydrated for 45 minutes in O_2-free water through which N_2 was bubbled. Mutations of A_n to a_n or X_c to x_c, expressed respectively as albino or xantha stripes or partial stripes, on otherwise green plants were scored from the third leaves up to the eighth leaves. As used here mutation is considered in the broad sense and may be attributable either to inactivation or alteration of the dominant A_n or X_c allele, or to loss of a chromosomal segment bearing either locus. The mutation rates per plant at X-ray doses of 0, 4,000, 8,000, 12,000, 16,000, 20,000 and 24,000 r for A_n to a_n were 0, 0.080, 0.122, 0.187, 0.261, 0.272, and 0.282, and for X_c to x_c were 0, 0,027, 0.061, 0.091, 0.135, 0.152, and 0.181, respectively. For comparison, homozygous normal seeds were irradiated with 12,000 r and 24,000 r of X-rays. At these 2 dosages mutation rates for albino stripes were 0.075 and 0.115, and those for xantha stripes were 0.043 and 0.058. The mutations observed in both the control and balanced lethals may include some mutations at loci other than A_n and X_c. However, the fact that mutation rates in the balanced lethal stock were significantly higher than in the control is good evidence that mutations at the A_n and X_c loci occurred frequently. In the balanced lethal stock the mutation at A_n was more frequent than that at X_c and both mutation rates increased linearly with dosage except that at higher doses the albino mutation approached a plateau. If chromosomal losses were frequently involved in mutations, then these results suggest that A_n may be distal to X_c.

KOSIN, IGOR L. *See* SATO, IWANE.

KOSSIKOV, K. V. The Frequency of Directed Changes of the Fermentative Properties of Yeasts as a Function of Concentration in the Medium of the Specific Substrate and of the Temperature of Cultivation. *Institute of Genetics, Academy of Sciences of the USSR, Moscow, U.S.S.R.*

It becomes ever more apparent from the experimental evidence on adaptative changes of micro-organisms to toxic substances and to new nutrition sources that these changes cannot be accounted for by spontaneous mutation and selection. The author's previous publications have shown that the specific substrate available in the medium may elicit directed changes of the fermentative properties of yeasts. It was found that the new property, viz., the capacity to produce an active ferment and to ferment the respective sugar, is steadily maintained even after the elimination of the sugar to which adaptation has been elaborated (this is replaced by another sugar) and is inherited not only through vegetative but also through sexual reproduction. In the latter segregation is noted.

The increase of sucrose concentration in the medium up to a certain limit greatly accelerates the adaptation of *Sacch. globosus* to fermentation of this sugar: the number of adapted forms increases by more than twentyfold. Not only does this evidence confirm the previous data as to the direct effect of the specific substrate on the hereditary changes of the fermentative properties but a correlation is thus found between the frequency of changes and the number of carbon molecules dissolved in the medium and reacting with the cell protoplast.

An acceleration of the process of adaptive changes of the fermentative properties of yeasts has likewise been recorded with increase in temperature of cultivation.

It may be suggested from the above evidence that the variability of the fermentative properties of micro-organisms is connected with their functional state as defined by the nutrient substrate and the cultivation temperature.

KREIG, DAVID R. Mutation Induced in Bacteriophage by Ultraviolet Light. *Biology Division, Oak Ridge National Laboratory, Oak Ridge, Tenn., U.S.A.*

Various reports have indicated that irradiation of host bacteria might be a necessary condition for ultraviolet-induced mutation of bacteriophage (Weigle, 1953; Latarjet, 1954; Tessman, 1956). Although the genetic variants that have been found in experiments involving irradiated bacteria may have been actually induced mutants, an alternative suggestion has been that they originate in some kind of radiation-induced recombination between phage and host. An investigation of induced back-mutation in T4*r* bacteriophage was undertaken in the hope of discriminating among the various interpretations. Genetic recombination between this virulent phage and its host, *Escherichia coli*, is probably not possible. Rare r^+ phage may be selectively assayed without the complication of phenotypic mixing. Unirradiated strain B bacteria were multiply infected with ultraviolet-irradiated T4*r* phage and the progeny phage resulting from multiplicity reactivation were scored for the frequency of r^+ back-mutants. Up to fiftyfold increase of r^+ phage frequency was found after this treatment in experiments with T4*r*59. Stocks of this mutant have a very low frequency (about 10^{-8}) of spontaneous back-mutants. Parallel experiments show that the increase cannot be accounted for by favored growth of pre-existing r^+ phage. Different *r* mutants have been compared for their capacity for induced back-mutation. Initial experiments support the working hypothesis that the lower the spontaneous level of back-mutants the higher the factor of increase from radiation-induced mutation, except that genes incapable of spontaneous back-mutation also give no induced back-mutants. The question may be considered whether the role of multiplicity reactivation in this system(and possibly similar phenomena in cases involving irradiated host bacteria) is simply to permit examination of large populations after high doses. This question should be answerable by varying the conditions of multiplicity reactivation.

KROKOWSKI, E. *See* EHLING, U.

KÜHN, ALFRED, and ALBRECHT EGELHAAF. The Action of the Mutation *a* in *Ephestia kühniella* on the Formation of Kynurenin from Tryptophan. *Max-Planck-Institut für Biologie, Tübingen, Germany.*

Incubation of L-tryptophan with homogenates of larval testes, fat body, or adult ovaries of a^+/a^+ animals (*Ephestia kühniella*) results in production of kynurenin. Homogenates from *a*/*a* animals are ineffective. D-tryptophan and tryptamin are not oxidized. The kynurenin produced was identified by chromatographic comparison with known synthetic kynurenin, by several color reactions, and by the UV-absorption spectrum. Quantitative determinations were made by measuring the fluorescence of chromatographically separated spots. The amount of kynurenin formed *in vitro* is proportional both to the amount of tissue and to the reaction time. These results indicate that a consequence of the mutation $a^+ \rightarrow a$ is the absence or inactivating of the tryptophan-oxidizing system in the mutant tissues. To test the possibility of an inhibitory effect of the *a* homogenates, aliquots of homogenized ovaries of a^+ and *a* females were mixed and incubated with tryptophan. Kynurenin formation was not blocked; in fact, kynurenin formation was as high as if both components had been a^+. If more *a*-homogenate was added the production of kynurenin was, within limits, proportional to the amount of brei used. But the addition of heat-denaturated and resuspended *a*-homogenate did not cause an increase in kynurenin production.

It is concluded that (1) the failure of *a*/*a* tissues to oxidize tryptophan *in vitro* is not due to the presence of an inhibitor, and (2) it seems highly probable that at least two steps are involved in this reaction (as is already known from the tryptophan-oxidase system of mammalian liver). That step which is not absent in a/a would be the limiting step in $a + a^+$ brei mixtures.

Kunicki-Goldfinger, Wladyslaw, Tadeusz Lachowicz, and Maciej Tabaczynski. The Role of Cytoplasm in Lingering Modifications in Bacteria. *Department of Microbiology, University and Institute of Immunology and Experimental Therapy, Wroclaw, Poland.*

This study was undertaken to elucidate the mechanism of some induced, heritable variations in bacteria, observed in experimental conditions excluding the selection of spontaneous mutants.

It was ascertained that subeffective concentrations of penicillin induced in certain conditions the appearance of several variants in *Micrococcus pyogenes* v. *aureus*. These variants only rarely were penicillin-resistant and a few were penicillin-dependent. The majority of them did not differ from the mother strain in their resistance; many were slightly less resistant and some exceedingly susceptible to the antibiotic. Examination of the growth rates of these variants in various cultural conditions, with and without penicillin added, in pure as well as in mixed cultures, has shown that their appearance was due to the induction by the antibiotic rather than to the selection of spontaneous mutants. Some experiments on the kinetics of appearance of these variants suggested the alteration in cytoplasmic make-up of bacterial cells as a cause of observed changes.

This problem was further studied using *Escherichia coli*. Permanent and semi-permanent changes in streptomycin-resistance and other physiological characters were obtained as the result of some imbalance in the relative rate of formation of cytoplasmic constituents. The imbalanced growth was produced in the cells by changes in the temperature of incubation or by modifications in the composition of cultural medium.

In some defective mutants of *E. coli* the back-variation to prototroph-state induced by the presence of specific metabolites in appropriate concentrations, when some synthetic reactions in the cells were impeded relative to others.

Although the biochemical mechanism of all these changes was not studied it would seem reasonable, on the basis of results obtained, to consider this process as a kind of heritable cytoplasmic alteration ("Dauermodification").

Kupzow, A. J. A Parallelism in Variablity of Plant Species with Certain Common Characters. *Moscow, U.S.S.R.*

Vavilov's law of the homologous series has an enormous value for genetics and plant breeding. This law establishes a parallelism in the evolution of constructively similar genotypes. But its author restricts this law considerably when he writes that the homologous series of variation are characteristic for taxonomically near groups of species, in spite of the homologous series in the variability of root-crops and different trees, which were known to him and were cited in his papers. This nonconformity of the law formulation with the facts on which is is based was not noticed by Roemer either. In the meantime the extension of Vavilov's law beyond the limits of taxonomically near groups of species is necessary according to its essential spirit.

It is now evident that all genetic similarity is the cause of homologous series in variability. This similarity can be in characters of taxonomical value, and therefore we have homologous series in species of one genus or in species of one family. But there are similar evotypes of different species from remote genera and families, and we have also for this reason homologous series in groups of analogous ecotypes of different species. Some characters without taxonomical and ecological value can also be similar in remote species. Therefore the root crops have the homologous series in the form of the roots, the different trees in the form of their tops, the Mexican *Cactaceaes* and South African *Euphorbiaceans* in the form of their succulent stems, and species with certain basic pigments in the colour of flower, fruit, seed and other organs.

The first cause of this phenomenon is the nomogenic similar mutations of genotypes with common elements of structure. Our taxonomy reflects only the similarity in certain parts of genotypes (the genes of morphological characters of taxonomical value), while their other parts can be very different in one taxonomical group. And vice versa, certain genotypes in different distant taxonomical groups can be very similar in their separate parts (the genes of physiological value or of any morphological characters without taxonomical value).

The second cause of the cited parallelism in variability is evidently the elimination of abortive genetic complexes rising as a result of mutations by selection.

Thus the parallelism in variability probably leads to the logical necessity of accepting the nomogenic mutations as an essential factor of the evolution. These mutations are controlled by natural and artificial selection in the case of adaptive or useful characters, but they are beyond this selective control in the case of ecologically and economically indifferent characters. Nevertheless these nomogenic mutations do not diminish the leading role of selection in the evolution, but emphasize it still more, since the selection of original forms predetermines their mutations and therefore directs their future evolution even in characters indifferent for selection.

KUSHNER, DONN J. Development and Properties of Alkali-Resistant Strains of *Bacillus cereus. Forest Insect Laboratory, Science Service, Canada Department of Agriculture, Sault Ste. Marie, Ont., Canada.*

Bacillus cereus, a pathogen of the larch sawfly, *Pristiphora erichsonii* (Htg.), grows in the midgut of the larva and is thought to attack it by producing a toxic phospholipase there. The midgut pH range (7.2–8.5) of larch sawfly larvae is one in which the bacteria can multiply rapidly, but in a number of lepidopterous larvae, the midgut pH is too high (9.5–10.5) for normal *B. cereus* to grow. It was thought that if a strain of *B. cereus* could be induced to grow at such high pH values it might prove pathogenic for Lepidoptera.

By extended serial cultivation in media of progressively higher pH, a strain of *B. cereus* has been developed that can grow at pH 10.5. These organisms, and others trained to grow at intermediate pH values, are being maintained on buffered alkaline agar. Their alkali resistance is not lost upon several transfers on neutral medium.

Alkali resistance appears to develop in a stepwise manner through exposure to alkaline medium and is not due to selection of mutants originally present. Inoculation of even large numbers of the sensitive organism into highly alkaline medium does not result in growth. The resistant organisms retain their rod shape but are shorter and thinner than the original strain. Resistant organisms growing on alkaline medium lower the pH of the medium. The fall in pH accompanies but does not precede growth. A discussion of the possible mechanism of resistance as well as of the mode of development of resistance will be given.

KUSHNER, H. F. Inheritance of Changes in Feathering Pigmentation in Fowls (hens) Subjected to Foreign Blood Transfusion. *Institute of Genetics, Academy of Sciences of the USSR, Moscow, U.S.S.R.*

The pattern of inheritance of pigmented feathering observed in White Leghorns following the transfusion to the latter of blood from New Hampshires and gray semi-wild ducks has been studied.

Hens of the second generation with pigmentary spots in their feathering, when mating with cocks (also of the second generation) having the same partly pigmented feathering from the experiment in which the parental pairs were not subjected to foreign blood transfusion, produce a third generation of chicks 26% with the parental type of feathering and 34% with entirely pigmented gray-striped feathering (barred).

In the parental pairs of the second generation, the parents themselves were pure white notwithstanding the fact that their ancestors underwent blood transfusion. Where the parents themselves were not subjected to any more blood transfusion, 17·3% of the offspring had partially pigmented feathering and 1.9% were pigmented all over.

Other similar experiments suggest that blood transfusion in hens—even when it does not seem to affect the colour of feathering of the first generations—frequently affects their heredity since in subsequent generations, repeated foreign blood transfusion being excluded, chicks appear with pigmented feathering.

The hereditary nature of the observed changes in birds' feathering is also confirmed by the following experiments.

When mating F_2 gray-striped hens with similar cocks of the second generation (without subjecting them to the foreign blood transfusion), 93% of the resulting chicks had fully gray-striped pigmentation. (barred). When mating experimental cocks of the second generation, themselves partly pigmented, with the control pure-bred White Leghorn hens, ancestors thereof and themselves not being subjected to blood transfusion, 23.5% of offsprings had partly pigmented feathering. When mating such control Leghorns with an experimental gray-striped cock of the second generation 64% of offsprings had pigmentary spots in their feathering.

In a specially conducted control test White Leghorns were subjected to blood transfusion from the hens of the same strain; in the first generation so far studied no deviations from the standard feathering of this strain have been observed.

The physiological processes responsible for the observed hereditary variations in the pigmentation of feathering (as well as in that of the beak and legs) are still obscure, but further studies are being conducted.

LaChance, Leo E. The Role of Chelation in the Production of X-Ray Induced Dominant Lethals in *Habrobracon. Genetics Department, N.C. State College, Raleigh, North Carolina, U.S.A.*

Four groups of virgin *Habrobracon* wasps, comprising (1) controls, (2) EDTA-fed, (3) X-irradiated, and (4) EDTA-fed and X-irradiated, were compared for egg production and hatchability subsequent to treatment. The percentage of embryonic dominant lethals was calculated by the comparison of hatchability of the eggs from females given identical treatments, some mated and some left unmated for the parthenogenetic production of haploid males.

Data were collected throughout the reproductive life of the females. Those embryos which were derived from eggs in different stages of meiosis and oogonial mitosis at the time of treatment were identifiable on the basis of ovariole morphology.

Females were allowed only a single meal of the chelating agent, 0.1 M EDTA as the disodium salt. In those groups which were fed the chelator and then irradiated, the dominant lethality was much greater than it was in either the irradiated or the EDTA fed groups. It was also greater than could be expected if the two agents were independent in action or merely additive. Thus the action of the two agents is believed to be synergistic.

The role of EDTA in the enhancement of induced genetic lethals can be attributed perhaps to one or more of four pathways: (1) the chelation of metal ions at the site of ionic breaks, which would prevent the normal restitution of the chromosomes; (2) enhancement of radiation damage via the inhibition of enzymes necessary to normal restitution, since many enzymes important in biosynthesis are dependent on metal ions for proper activity; (3) inhibition of the Fe dependent enzymes peroxidase and catalase which are responsible for the biological breakdown of peroxides formed in tissue irradiated in the presence of oxygen. (4) interference with normal restitution of chromosome breaks due to altered viscosity of the nucleoplasm.

(This investigation was supported by a predoctoral research fellowship (AF–6540) from the National Institutes of Health, U. S. Public Health Service. Appreciation is expressed to the Dow Chemical Company for providing the chelating agent.)

Lachowicz, Tadeusz. *See* Kunicki-Goldfinger, Wladyslaw.

La Cour, L. F., and S. R. Pelc. The Incorporation of Tritiated-Thymidine in the Nuclei of Roots of *Vicia faba. John Innes Horticultural Institution and Biophysics Dept., King's College, London, England.*

The incorporation of tritiated-thymidine in the DNA of nuclei in roots of seedlings of *Vicia faba* has been studied by the autoradiograph method. In meristematic cells the labelled compound is incorporated only during a part of interphase. Autoradiographs of mitotic figures following growth with and without colchicine indicate that the hypothesis of chromosome duplication proposed by Taylor *et al.* (1957) may need some modification. A proportion of resting nuclei in the zone of cell elongation gives more intense autoradiographs than do nuclei in the meristem of the root tip. At first this more intense labelling is observed in nuclei immediately adjacent to the 2–3 mm. of meristem but with time it extends further into the zone of root elongation.

Photometrical measurement of Feulgen stain in resting nuclei adjacent to the meristem has shown that a large proportion of them contain a 4C (prophase) amount of DNA. Thus the intensity of labelling in these nuclei cannot be attributed either to polyteny or to polyploidy. It is suggested that unlabelled thymidine is replaced by labelled thymidine in unlabelled strands in the chromosomes at the time these cells cease to be meristematic.

LACY, ANN MATTHEWS, and DAVID M. BONNER. Complementarity between Alleles at the Td Locus in *Neurospora crassa. Department of Microbiology, Yale University, New Haven, Conn., U.S.A.*

The genetic locus which controls the formation of the enzyme tryptophan synthetase in *N. crassa* has been termed the Td locus. This enzyme, which carries out the final step in tryptophan synthesis, is measured by its ability to catalyze the condensation of indole and serine to form tryptophan. In the past few years, a number of independently occurring mutants defective at this locus have been isolated. All of these mutants are phenotypically similar in that they do not form an amount of tryptophan synthetase detectable by the enzyme assay. Some of these mutants have been shown to differ from each other in terms of temperature sensitivity, specificity of suppressor genes, formation of immunologically cross-reacting material, and indole accumulation, suggesting that the effect on tryptophan synthetase production is not the same in each instance. A functional difference between the isolates is also suggested by the formation of occasional pseudo-wild type progeny (intra-nuclear complementation) from crosses between certain of these mutants.

These observations made it desirable to study the possibility of heterocaryon formation between Td alleles. Preliminary tests gave no indication of complementarity. However, various mutants were back-crossed to a heterocaryon positive (het+) wild type organism and more nearly isogenic mutant strains isolated. Combinations of these isolates were tested and some were found to form tryptophan independent heterocaryons, although the time required for their formation was considerably longer than that for heterocaryon formation between non-allelic mutants.

The results of these studies indicate that at least three groups of mutants can be determined on the basis of complementarity. The characteristics of the tryptophan synthetase formed by various heterocaryons is currently under investigation and will be discussed.

LAGERVALL, MATS. The Correlation among Individuals Caused by Dominance. *Department of Animal Husbandry, Iowa State College, Ames, Iowa, U.S.A.*

The "coefficient of relationship" (Wright, Genet. *6*: 111–143) and the "coefficient de parenté" (Malécot, Les mathématiques de l'hérédité, Paris, 1948) express in slightly different ways the relationship between two individuals on a purely additive basis. Both are functions of Wright's inbreeding coefficient, F. In this study an attempt was made to evaluate the corresponding relationship that is caused by dominance.

Suppose the individuals X and Y possess the genotypes ab and cd, respectively. The correlation between X and Y due to dominance can then be expressed as $P\ (ab = cd)$. For calculating purposes it can be written as $P\ (a = c)\ P\ (b = d/a = c) + P\ (a = d)\ P\ (b = c/a = d) - P\ (a = b = c = d)$.

For regular inbreeding systems $P\ (ab = cd)$ can be evaluated with the help of mating matrices (for the algebra, see, e.g., Kempthorne, An Introduction to Genetic Statistics, New York, 1957) and expressed as a function of F. However, even for the full sib mating the function turns out to be rather complicated. In irregular inbreeding systems the event $(a = c)$ is often independent of the event $(b = d)$ as well as the event $(a = d)$ of the event $(b = c)$. In such cases the above-mentioned formula can be simplified and $P\ (ab = cd)$ can be written as a function of F in the following way:

$$F_{A\times C}\, F_{B\times D} + F_{A\times D}\, F_{B\times C} - F_{XP}\, F_{YP},$$

where $F_{A\times C}$ = the inbreeding coefficient of the offspring that would theoretically result from a mating between X's sire (A) and Y's sire (C); B = X's dam; D = Y's dam; F_{XP} = the inbreeding coefficient of X with respect to P, an ancestor common to A, B, C, and D; etc.

The probability dealt with in this paper was denoted u_{XY} by Kempthorne (1957) and as such included in the general formula for cov (X, Y). Besides the value this coefficient of relationship caused by dominance has in itself, its estimation is thus necessary for the calculation of cov (X, Y). (This work was done during the tenure of an F. A. O. André Mayer Research Fellowship. Financial aid was also given by Helge Ax:son Johnsons Stiftelse, Sweden, and by Skandinaviska Bankens Stipendiefond av 1931, Sweden.)

LANDAUER, WALTER. On Phenocopies, Their Developmental Physiology and Genetic Meaning. *University of Connecticut, Storrs, Conn., U.S.A.*

A review will be given of recent studies on the chemical production of phenocopies in *Drosophila* and chicken embryos. The first part of the review will present the general conclusions to which this work has led in regard to the external and internal factors which play a role in the origin of phenocopies. These conclusions will then be discussed with reference to their meaning for developmental physiology and genetic theory. It will be maintained that it is unnecessary to assume specific isoalleles and specific modifier systems for the interpretation of the known facts. On the contrary, it will be proposed that phenocopies arise as reactions of particular genotypes to external conditions with which the homeostatic forces of the developing organisms are unable to cope.

LASKOWSKI, WOLGANG, and WERNER STEIN. The Effects of X-Rays, UV, and other Inactivating Agents on the Budding Ability of Saccharomyces Strains of Different Ploidy. *Max-Planck-Institut f.vergl. Erbbiologie and I.Physikalisches Institut, Free University, Berlin-Dahlem, Germany.*

The microscopic pattern of rest-budding in X-ray, UV, or peroxide-treated yeast cells was studied in haploid and diploid strains of Saccharomyces.

UV-irradiation resulted in all investigated strains in a very similar pattern, i.e., by a given percentage of macroscopic survivals approximately the same final frequencies of more than one and also of more than three cells in a clone. It is possible to explain these results by a non-strain-depending dose reduction factor of 2.2 : 1 for the frequency of more than one cell, and 1.2 : 1 for the frequency of more than three cells, both related to the commonly used macroscopic survival frequency curve. The dose reduction by photo-reactivation was also approximately 2.2 : 1 and caused essentially a corresponding change of the pattern.

After treatment with organic peroxides the pattern in haploid strains was very similar to that after UV treatment although there was no photo-reactivation. In diploid strains there is a characteristically different pattern with almost none rest-budding. It seems remarkable that this basic change of the pattern occurred even if an endomitotically originated diploid strain was tested. This strange phenomenon demands a specific genetic interpretation.

For X-ray treated strains there could also be observed a dose reduction principle for the criteria > 1 cell, > 3 cells, and macroscopically visible clones. For a haploid strain these dose relations were about 30 : 1.33 : 1, and for a diploid strain about 10 : 1.65 : 1. In one respect the X-ray induced pattern was different compared with the pattern after UV treatment: the number of single cells after more than 48 hours incubation was—at least within a certain dose range—significantly smaller than after UV treatment. In reasonable agreement with this fact there was nearly no retardation of the first budding step. This holds for every strain and every dose tested. In contrast with the X-ray experiments a retardation of the first budding step was observed after UV and peroxide treatment in all strains tested. The criteria used in these experiments offer new aspects for a discussion of inactivating mechanisms.

LAUPRECHT, EDWIN, and EDWARD WALTER. On the Valuation of Methods to Form Certain Gene Combinations by Breeding. *Max-Planck-Institut für Tierzucht und Tierernährung, Abteilung für Tierzüchtung und Haustiergenetik, Niedersachsen, Germany.*

There are different methods of forming a certain gene combination $A_1A_1\ A_2A_2 \ldots A_nA_n$ by breeding when starting with types such as $A_1A_1 \ldots A_mA_ma_{m+1}a_{m+1} \ldots a_na_n$ and $a_1a_1 \ldots a_ma_mA_{m+1}A_{m+1} \ldots A_nA_n$ where the final aim can be approached slowly by alternately crossing and selecting. After each crossing the resulting combinations can be classified in states by the extent of their approach to the desired gene combination. The breeding method to be applied here can be represented by a stochastic matrix (p_{ik}) similar to the representation of a regular system of inbreeding by a generation matrix; p_{ik} is the probability for the transition from the i^{th} to the k^{th} state in a time unit. If no step in the breeding process will result in a decline, then $p_{ik} = 0$ for $k < i$. In this case the eigenvalues of the stochastic matrix are given by p_{ii}. The value of a breeding method depends on the average number of time units or the average number of individuals necessary to establish a desired gene combination.

Another way of evaluating a breeding method is based on the number of time units necessary to establish with a given probability α the desired gene combination. When α is large it is sufficient to use the largest non-unit eigenvalue of the matrix as a measure. These methods of valuation can be applied in self-fertilised as well as in cross-fertilised populations.

LAVEN, H. Cytoplasmic Inheritance and Speciation in Mosquitoes. *Max-Planck-Institut für Biologie, Tübingen, Germany.*

The family of mosquitoes (Diptera:Culicidae) is rather uniform in morphology. Studies on the bionomics of anopheline mosquitoes have revealed that in several instances the morphologically defined species are, in fact, complexes of sibling species. Crossing experiments among populations of the common mosquito *Culex pipiens* from Europe, Africa and North America have shown that this "species" also contains an undefined number of sibling species. Full isolation or unilateral isolation of the sibling species in this group comes about by cytoplasmic inheritance. Factors, as yet unknown, which are independent of chromosomal genes determine the viability of hybrid embryos. The cytoplasmic agents are characteristic for every "species" in the complex and they are transmitted by way of the egg cytoplasm as well as by the sperm. Some observations in other genera of the culicines give support to the idea that this long unknown isolation mechanism might be effective generally in the family of mosquitoes for speciation and evolution.

LAWLER, SYLVIA D. Some Observations on the Gm Serum Protein Groups in Man. *Galton Laboratory, University College, London, England.*

The Gm serum groups in man were discovered by Grubb (Acta path. microbiol. scand. *39*:195). There are two phenotypes, Gm(a+) and Gm(a—). The groups are determined by a serological system involving the following carefully selected constituents: human Rhesus positive red cells strongly sensitized with an "incomplete" anti-D serum + serum from a patient with rheumatoid arthritis → agglutination. The agglutination is inhibited if serum from a Gm(a+) individual is added to the system; it is not inhibited, or inhibited but weakly, by the serum of a Gm(a—) individual.

A study has been made of the serology and genetics of these groups. Some results of population and family studies in Great Britain and Ferrara (Italy) will be given.

LEBEDEV, M. M. Influence Exercised on Characteristics of Offspring by Premating Treatment of Animals and Fertilization Conditions. *Pushkino Scientific Research Laboratory for Stock Breeding, Moscow, U.S.S.R.*

Charles Darwin used to say on the basis of his observations that there was hardly a more amazing thing in nature than the sensitivity of sex cells to external influences. The intensive assimilation activity on which this phenomenon is based can be clearly observed in experiments carried out by means of tracer atoms. Radioactive P^{32} and Ca^{45} introduced into the food or directly into the blood stream of the animals, rapidly accumulate in the spermatozoa of cocks, rabbits and rams, as well as in chicken eggs. Experiments made with the intervarietal transplantation of gonads in animals and with blood transfusion in chickens prove the possibility of changing the properties of offspring by establishing new conditions for the development of gametes.

The characteristics and viability of offspring largely depend on the differentiation of the gametes taking part in the fertilization process, on the nature of the food received by the animals and their maintenance previous to mating, their age and condition at the moment of mating.

Fertilization is a complex process of mutual assimilation by the merging sex cells. The ultimate maturing of the ova and their fertilization take place during their contact with more or less numerous spermatozoa. A particular feature of the fertilization process in all farm animals consists in the mass penetration of spermatozoa into the transparent membrane of the ovum. Not the head of the spermatozoon alone, but the entire spermatozoon including its tail penetrate into the plasm of the ovum.

In a number of cases several spermatozoa penetrate into the plasm of the ovum simultaneously, leading to the formation of three or more pronuclei. In chickens the mass penetration of dozens and even hundreds of spermatozoa into an ovum is the rule. The spermatozoa often penetrate both into the ovum and into the zygotes in the process of division.

Numerous experiments carried out with rabbits, pigs and chickens show that in these animals and birds fertilization is of a selective nature.

A dependence has been established between the number of spermatozoa which penetrate into the ova and the zygotes, the fertilization rate and the development of the embryo. Heterospermatic insemination of females with the semen of different males as well as an additional insemination of females after the termination of the basic fertilization enhances as a rule the viability of the offspring. On the basis of experiments carried out with chickens, there is reason to believe that heterospermatic insemination can, in certain cases, influence the heredity of the offspring.

All these experimental studies are graphic proof that by changing the conditions of fertilization man can exercise a considerable influence on the characteristics of the offspring. An example of the active interference into the fertilization process is the so-called double mating method of pigs evolved by the Pushkino Laboratory of Stockbreeding.

The application of this method to hundreds and thousands of pigs in large herds has contributed to a considerable reduction in the barrenness of sows, to the heightening of their fertility, and to improved characteristics of their offspring.

A tremendous influence on the developing foetus is exercised by the maternal organism, a fact which has been proved by numerous observations of reciprocal crossing of animals belonging to different varieties and species, as well as by experiments on the vegetative hybridization of animals.

LEDERBERG, ESTHER M. Fine Structure of the Gal Loci in *Escherichia coli* K-12.

Genetics Department, University of Wisconsin, Madison, Wis., U.S.A.

A distinctive recon (one of a group of closely linked loci separable by recombination) has been assigned to each of ten independently occurring Gal — (galactose non-fermenting) mutants. All the mutants were obtained after UV irradiation except Gal_3 which was spontaneous. Allelism was tested by large-scale matings and by transduction analysis. Prophase-linked transduction via HFT λ, where practically every phage particle may result in a transductional event, produced heterogenotic clones when donor and recipient bore distinctive recons. The heterogenotes were unstable, segregating the two input and two crossover classes (Morse, Lederberg and Lederberg, 1956). Two cistrons (cis-trans position effect groups) had been demonstrated: with members of the same cistron trans heterogenotes are phenotypically mutant. Galactokinase was missing in mutants of one cistron (Gal 2,8) while UDP transferase activity was absent in the other (Gal 1, 4, 6, 7), a defect corresponding to human congenital galactosemia, (Kalckar, Kurahashi, 1957). Gal_3^- and Gal_9^- are genetically cistronic with both of the foregoing groups; they have not yet been successfully analysed for their enzymatic defect. Among two hundred new mutants, no recons identical with the first ten have recurred. Most have been assigned to either of the first two cistronic groups, but a small number which would represent a fourth genetic group have given only normal galactose-positive heterogenotes with every standard Gal^- tested. A few mutants were not transformable by λ but were found to carry other modifiers including that of hexose metabolism which obscure their relationship to the Gal^- group. An attempt was made to map the Gal markers in linear sequence by their relationship to the Lp locus. Intercrosses of Hfr $M^-Gal_x^- \times F^-Gal_y^-$ were made on a medium which selected efficiently for $M^+Gal_x^+Gal_y^+$ recombinants, and these were then scored for the segregation of an Lp marker. However, the linkage of Gal-Lp proved to be not close enough to compensate for the perturbations of segmental loss from the Hfr parent, and the data were indecisive.

LEE, WOONG-JIK. Physiological Effect of Gamma-Radiation on Meiosis in Rye.

Department of Biology, College of Education, Seoul National University, Seoul, Korea.

During the work concerning the effect of gamma-radiation on meiosis in rye, in 1956, a marked physiological effect was observed. A vernalized Korean rye containing 14 ordinary chromosomes was irradiated with Co^{60} in dose of 150 r (7 r per minute). The temperature during irradiation was maintained between 21° and 22°C. In control or before irradiation, meiosis was quite normal except for unpaired chromosomes and chromosome bridges in a few cells. Chromosomes showed uniform stain capacity.

Immediately after irradiation, inhibition in meiosis was noticed. At the first metaphase, many bivalents formed rings and pronounced nucleic acid starvation was found in most chromosomes. Heterochromatic regions were found to be spherical hollows or holes in a majority of chromosomes. In extreme cases undercharging in nucleic acid was so marked that coiled spirals were visible.

Six hours after irradiation, gradual recovery was noticed although nuclear development was still inactive. Nucleic acid starvation was not so serious as in the previous stage, but surface stickiness and fusion of chromosomes were very apparent. In 12 hours, recovery was more marked. Sticky bridges, dicentric chromosome bridges accompanied with acentric fragments, and lagged fragments were found in many first anaphases. In 24 hours, suitable stage for analysis had not been obtained, presumably because of an upset in timing by irradiation.

It is clear that nucleic acid starvation in chromosomes immediately after irradiation was followed by surface stickiness and fusion of chromosomes due to overcharged nucleic acid. Then it proceeded toward chromosome breakages.

(I wish to thank Professor P. T. Thomas for his advice. An award of a grant by the British Council is gratefully acknowledged.)

LEGATES, J. E., B. R. FARTHING, and C. C. COCKERHAM. Selection for Growth and Maternal Performance in Mice. *North Carolina State College, State College Station, Raleigh, N.C., U.S.A.*

Selection for individual 6-week weight and 12-day weight of a litter of 6 mice has continued for 9 generations in a population arising from a cross of 4 inbred lines (A, BALB/c, AKR, DBA/2) obtained from the Roscoe B. Jackson Memorial Laboratory. Altogether 4 selection lines, for low and high 6-week weight and for low and high 12-day weight, are maintained as populations of 10 males each mated to 2 females. A control population consisting of 15 males each mated to 2 females is also maintained.

The first 9 generations of intra-litter selection for 6-week weight has resulted in a divergence equal to 24.1% of the performance in the base population (mean, 18.6 gm.). Selection for 12-day litter weight has resulted in a divergence equal to 13.0% of the performance of the base population (mean, 39.9 gm.). There have also been correlated responses for each of the above traits equivalent to 16.7% of the mean for 6-week weight and 10.5% of the mean for 12-day weight.

Our control has followed the high line for 12-day weight quite closely, but it has remained more nearly equidistant between the low and high 6-week weight line. The control was reconstituted and its performance at the time of the ninth generation of selection was slightly superior to the contemporary performance of the control line.

A cross nursing study also has been employed to assess the relative contribution of prenatal and postnatal factors on body weight at 5, 12, and 21 days and 6 weeks. In our material postnatal influences were found to be most important in determining weight through weaning (21 days). Postnatal effects accounted for 71.5% of the variance in the 12-day weight of litters of 6 mice, which is the measure of performance used in selection.

LEJEUNE, JERÔME, RAYMOND TURPIN, and MARIE ODILE RETHORE. Sur les variations de la masculinité dans la descendance de parents irradiés. *Faculté de Médecine, Paris, France.*

Ainsi que l'ont montré de précédentes enquêtes, la masculinité à la naissance (nombre relatif de garçons) diminue dans la descendance des femmes dont les ovaires ont été irradiés. L'irradiation des gonades paternelles semble influer elle aussi sur la masculinité de la descendance, mais le sens de cette variation pourrait dépendre des modalités d'application du rayonnement. La présentation et l'analyse de données nouvelles autorisent une discussion sur l'existence et la signification de ces phénomènes.

LERMAN, L. S. Estimation of the Critical DNA Segment Required for Genetic Transformation. *Department of Biophysics, University of Colorado Medical Center, Denver, Col., U.S.A.*

The kinetics of the loss of transforming activity of pneumococcal deoxyribonucleic acid indicate that each particle is inactivated by the introduction of a single molecular defect. Since the extent to which the inactive DNA is incorporated by competent cells is only slightly affected, it is likely that the transformation failure lies in genetic processes. Where the rate of accumulation of molecular alterations can be determined independently, the length of the active DNA segment which is vulnerable to a single attack can be calculated.

Results of these calculations by several independent methods indicate that the critical segment contains roughly three thousand nucleotides, and constitutes, therefore, only a fraction of the length of an intact DNA molecule, which is of the order of twenty thousand nucleotides. Neither the estimate based on the rates of hydrolysis and inactivation by deoxyribonuclease nor that based on ultraviolet inactivation requires a direct measurement or assumption regarding molecular weight.

The lengths of the critical segments have been determined for the unlinked transformations to resistance to streptomycin, novobiocin, and optochin. These are found to be identical within experimental error.

LERNER, I. MICHAEL, EVERETT R. DEMPSTER, and NOBUO INOUYE. Preliminary Report on X-ray Induction of Variability in Polygenic Traits of Chickens. *University of California, Berkeley, Calif., U.S.A.*

A flock of White Leghorns has been under continuous selection for egg production since 1933. The mean number of eggs laid annually per pullet housed is currently about one hundred eggs higher than in the foundation stock. It is, however, not entirely clear whether selection gains have now ceased although it appears highly likely that they have decelerated. An experiment intended to determine whether genetic variation in egg-production characters can be induced by X-rays and subsequently utilized to obtain further genetic progress was initiated in 1952. The first phase of this study consisted of propagation without artificial selection of a population (the *PX* line) extracted from this flock (designated *P*) in which the semen used to fertilize the dams was exposed to X-ray doses of either 1,000 or 1,500 r. A mating system approaching panmixia was used, and a control population (*PC*) reproduced in a manner identical to that for the *PX* line but without irradiation. After cumulative doses of 2,000, 3,000 and 5,500 r were applied, small contemporary samples of pullets from the *P*, *PC* and *PX* populations were produced without irradiation and data on a number of their production traits gathered. In addition, several tests on hatchability without irradiation of the *PC* and *PX* lines were carried out. Embryo viability seems definitely affected by exposure of semen of grandsires and more remote ancestors to X-rays. Thus the hatchability of the *PX* line is roughly half that of the *PC*, while crosses between them are intermediate. Probably both the means and variances of sexual maturity, egg number and egg weight have been affected. However, the answer to whether the induced variation can contribute to selection progress, will have to wait upon the outcome of the second stage of the experiment in which selection for egg production will be resumed in both the *PX* and *PC* lines.

LERNER, I. MICHAEL. *See* DEMPSTER, EVERETT R., *et al.*; LOWRY, DOROTHY C.

LESINS, KARLIS. Progenies from a Cross *Medicago dzhawakhetica* × *M. sativa*. *Department of Plant Science, University of Alberta, Edmonton, Alta., Canada.*

The original hybrid (*Medicago dzhawakhetica* × *M. sativa*) was a hexaploid ($2n = 48$) though both its parents were tetraploids ($2n = 32$). Morphological as well as physiological characteristics indicated that four genomes of *M. dzhawakhetica* were united with two genomes of alfalfa, *M. sativa*, the genomic constitution being DDDDSS. On backcrossing to tetraploid alfalfa a progeny of constitution DDSSS ($2n = 40$) was obtained; on repeated backcrossing this in turn gave DSSS $\frac{S}{2}$ ($2n = 36$). Another series of progenies was initiated by crossing the hybrid with a hexaploid alfalfa plant, DDSSSS being produced. Backcrossing this to hexaploid and tetraploid alfalfas gave progenies of constitution DSSSSS ($2n = 48$) and DSSSS ($2n = 40$) respectively.

Physiological traits, such as requirement of cold pretreatment for flower induction (a characteristic of *M. dzhawakhetica*), varied greatly with genomic constitution, though some variation was observed between plants of the same progeny. Thus, DDSSSS plants flowered freely, but some DDSSS plants rather sparsely, without pretreatment in cold.

Variation in morphological traits had the same trend. The large, articulate pod hairs characteristic of *M. dzhawakhetica*, dominant also in the hybrid, were represented only by rudiments on pods of DDSSSS, while on pods of DDSSS they were better developed; in some plants more so than in others.

The mean value of chromosome number of different progenies was lower than theoretically expected. There are several possibilities of genetic changes taking place during future generations: one, chromosomes of odd genomes may be lost without trace from the germ track; second, some extra chromosomes of *M. dzhawakhetica* or *M. sativa* may be incorporated in the genetical make-up; and further, some genetic exchange between chromosomes of both species may occur. Any hereditary change of economic value, which was the original objective of the cross, will be sought in coming generations.

LEUPOLD, URS. Studies on Allelism in *Schizosaccharomyces pombe*. *Institute of General Botany, University of Zurich, Zurich, Switzerland.*

A quantitative analysis of the meiotic formation of rare prototrophs in intragroup crosses between adenine-requiring mutants of two different groups (ad_2: 3 mutants accumulating hypoxanthine; ad_7: 11 mutants forming red pigment) has revealed a rough additiveness of the prototroph frequencies measured. This, together with the observation that any diploid clone combining two mutant genes of the same group is mutant in phenotype, suggests that these frequencies (which range from 3 to 750 prototrophs/10^6 ascospores) reflect frequencies of crossing-over recombining different mutable sites (ad_2: 3; ad_7: 9) within small chromosome sections which as a whole are acting as functional units. This interpretation may also apply to the mating type region, since crosses between heterothallic clones of opposite mating type are found to yield rare homothallic segregants (0.3%) which regularly recombine for neighbouring markers, suggesting that crossing-over between two different sites of the mating type locus is involved.

However, efforts to demonstrate the simultaneous formation, to be expected on the crossing-over hypothesis, of two complementary recombinants per recombination event, have not been successful so far. For the *ad*$_7$-region, an analysis of half-tetrads (i.e., of the haploid progeny of the rare prototrophic cells which are formed by mitotic recombination, at a rate of 0.3–3.5 reversions/10^6 cell divisions, within diploids combining mutant genes of independent origin) has failed, in 17 prototrophs analysed, to yield the reciprocal double mutant expected. Similarly, a tetrad analysis of the meiotic formation of rare homothallic recombinants, though confirming the intimate connection with crossing-over between neighbouring markers, has failed to demonstrate the simultaneous formation of a complementary recombinant recognizable by its mating behaviour; but it still remains to be determined whether this lack of reciprocity in phenotypic segregation (2 heterothallic + : 1 heterothallic — : 1 homothallic in 10 tetrads analysed) reflects a non-reciprocal segregation on the genetic level as well.

LEVINE, LOUIS, and JOHN A. BEARDMORE. Environment, Adaptation and Balanced Polymorphism in *Drosophila pseudoobscura*. *Biology Department, City College of New York* and *Department of Zoology, Columbia University, New York, N.Y., U.S.A.*

(i) The balanced polymorphism found in the third chromosome of *Drosophila pseudoobscura* is reflected in the equilibrium frequencies of the gene arrangements involved. These equilibrium frequencies are completely predictable (given flies from the same geographic population) in laboratory populations kept at 25° C, no matter what the initial frequencies may be. At 16° C, no change occurs, the adaptive values of all genotypes being equal. At intermediate temperatures it would seem reasonable to expect intermediate frequencies of gene arrangements. However, in two intermediate environments, replicated populations gave results which were extreme in terms of gene-arrangement frequencies at equilibrium and it is possible that these equilibria are stable even in new environments.

(ii) Crosses involving different gene arrangements between flies from different geographic populations have been shown often to be indeterminate in respect to an equilibrium. This means that it should be possible to demonstrate differences in heterosis in combinations of chromosomes derived from different laboratory populations both within and between environments as compared with crosses derived from a single population. Work testing this theory is in progress and will be reported on.

LEVINE, MYRON, and ROY CURTISS. The Induction of Aberrant Recombination Frequencies with Phage P22 of *Salmonella typhimurium*. *Biology Department, Brookhaven National Laboratory, Upton, N.Y., U.S.A.*

The clear-plaque mutants of the temperate phage P22 of *Salmonella typhimurium* affect the ability of the phage to become prophage. These mutants can be classified into three distinct but closely linked functional units or cistrons on the basis of their physiological interactions and their behavior in genetic crosses. The different mutants of a cistron have been mapped in a linear order (pseudoalleles). Crosses between many combinations of two clear-plaque mutants have been carried out. The rare wild-type temperate progeny phages arising by recombination between the closely linked mutant loci were examined for additional recombinations between the clear-plaque region and markers on both sides of the clear-plaque region. The four possible recombinant classes from such a cross are: a single recombinant class (the recombination taking place between the mutant loci), two double recombinant classes (the second recombination taking place to one or the other side of the clear-plaque region) and a triple recombinant class (the additional recombinations taking place on both sides of the clear-plaque region). Crosses with most of these mutants gave the expected frequencies of the four classes. Aberrant results were obtained in a few crosses between particular mutants. In these crosses one of the classes of double recombinants was larger than the single class. This extreme negative interference can be induced by two different treatments in crosses in which it does *not* normally occur. (1) Ultraviolet treatment of phage before infection causes the double recombinant class to exceed the single class. (2) Exposure of phage-infected bacteria early in the latent period to the antibiotic, chloromycetin, also produces this aberrancy. A number of possible explanations for these results will be discussed. (Research carried out at Brookhaven National Laboratory under the auspices of the U.S. Atomic Energy Commission.)

LEVINE, R. P. *See* EBERSOLD, W. T.

LEWIS, HELEN S. *See* LEWIS, HERMAN.

LEWIS, HERMAN W., and HELEN S. LEWIS. Genetic Control of Tyrosinase Systems in *Drosophila melanogaster*. *Massachusetts Institute of Technology, Cambridge, Mass., U.S.A.*

Genetic control of the tyrosinase system (enzyme, activator and inhibitor) of *Drosophila melanogaster* has been investigated with special reference to the action of the temperature mutant sable (s) and the interacting locus, suppressor of sable (su—s). Enzyme systems are prepared for analysis by homogenization of flies in phosphate buffer (pH 7.5) followed by extraction of lipids with chloroform. All operations are performed at 0°C. The tyrosinase activity of the supernatant is assayed by spectrophotometric measurement of formation of dopachrome following addition of excess substrate (dihydroxy phenylalanine in phosphate buffer pH 7.0) to the extract. Enzyme activity is expressed in tyrosinase units/gm. protein, one tyrosine unit being arbitrarily defined as that amount of enzyme equivalent to an increase in optical density at 480 mu of 1.0 per minute.

The tyrosinase activities of young adults of various genotypes grown at 25°C are as follows: wild type, 22; sable, 80; suppressor of sable, 204; suppressor of sable, sable, 210. In extracts of flies raised at 15°C there is proportionally greater enzyme activity. Comparisons on a time scale show differences in the enzyme activation process in various stages of development as well as an inverse correlation between tyrosinase activity and age. For example, the activity of sable stocks grown at 25°C is as follows: larvae, 316; pupae, 265; newly emerged adults, 80; aged adults, 22.

The tyrosinase activity of s/+ is intermediate between that of s/s and +/+. The kinetics of activation of extracts of s/+ is similar to that of mixtures of extracts of s/s and +/+. In both the *in vitro* and *in vivo* mixing, the activator behaves like that of the sable genotype whereas peak activity time is that of the wild type.

Kinetic studies of activation and inhibition, heat inactivation and pH experiments indicate that the various loci control the tyrosinase systems by exerting quantitative rather than qualitative effects.

LEWIS, JESSICA H., and C. C. LI. Genetic Considerations in Hemophilia A and B. *University of Pittsburgh, Pittsburgh, Pennsylvania, U.S.A.*

Two major types of hemophilia—A, due to a deficiency of the plasma protein "antihemophilic factor" (AHF), and B, due to a deficiency of a different protein "plasma thromboplastin component" (PTC)—are controlled by sex-linked, biochemically partially recessive genes. Type A is the classical hemophilia and comprises about 84% of the group. Extensive pedigrees—93 of Type A and 23 of Type B—were studied. In all 43% of A- and 52% of B-pedigrees showed the disorder in multiple sibships or generations.

Direct studies of sex ratio and hemophilic segregation were made by counting hemophilics' sisters' children and hemophilics' daughters' children. Among A-pedigrees there were 129 sisters' children sibships with a total of 452 individuals, of whom 233 (51.5%) were males and of these 77 were hemophilics (33% among males). Hemophilics' daughters' children (51 sibships) numbered 161. Of the 159 on whom the sex was known, 79 (49.7%) were males and, of these, 41 were hemophilics (51% among males). Among B-pedigrees there were 30 sisters' children sibships, containing 39 females, 37 males, and 6 sex unknown; 12 were hemophilics (calculated as 30% of male children). Hemophilics' daughters' children (22 sibships) numbered 74, of whom 49 (66%) were male. Of these, 22 were hemophilic.

Half of the sisters of hemophilics will be carriers. Thus, 25% of their male children would be expected to be hemophilics. Actually 33% hemophilics in A and 30% in B were found. Half of hemophilics' daughters' sons are expected to be hemophilic. In A 51% and in B 45% were. In the latter group the sex ratio showed an unexpected 66% males. If either the segregation for males or that for hemophilics among the males were more than 50%, as possibly suggested by the present studies, it would constitute another source for the supply of the hemophilia gene to compensate for its loss through selection in the population.

LEWIS, MARION, and BRUCE CHOWN. The Blood Groups of the Copper Eskimos. *Rh Laboratory, University of Manitoba, Winnipeg, Man., Canada.*

The blood of 348 Eskimos living in the Coppermine area was tested with the following antibodies, anti-A, A_1, B; M, N, S, s, He, Mi^a, Vw; P, Tj^a, C, C^w, c, D, E, e, V; K, k, Kp^a, Kp^b; Fy^a, Fy^b; Lu^a, Lu^b; Le^a; Di^a; Be^a, By^a; Yt^a and Zu, and the saliva of most of them tested for the presence of A, B or H polysaccharide. The following antigens were not found: He, Mi^a, Vw; C^w, V; K, Kp^a; Le^a; Lu^a; Di^a; Be^a; By^a. All bloods tested reacted with anti-D; k, Kp^b; Lu^b; Yt^a; Zu. All persons tested were secretors of A, B or H polysaccharide. In the ABO system there was a high frequency of A_1; in the MNSs system only two M—N+ bloods were encountered; S was usually partnered with M; in the Rh system only R_1, R_2 and r appeared to be present, r being traceable to white ancestors; in the Duffy system there was a higher frequency of Fy^b than in any other native population we have tested. In family studies there were no discrepancies from expectations.

LEWONTIN, R. C. The Destruction of a Heterotic System by Natural Selection. *Genetics Faculty, North Carolina State College, Raleigh, N.C., U.S.A.*

It is probable that the maintenance of balanced polymorphism due to heterosis is contingent upon fluctuation of the environment causing alterations in the fitnesses of homozygotes and heterozygotes. In a fairly constant enviroment it would be possible to find genes more fit in homozygous condition than in heterozygous state, and such genes would be fixed by natural selection with a concomitant loss of polymorphism. This hypothesis was confirmed by the following set of experiments. A population of *Drosophila pseudoobscura* containing two third chromosome inversions, Arrowhead and Pikes Peak, was established under constant conditions of food and temperature. The frequencies of the inversions reached an equilibrium state at about 83% Arrowhead and remained in that balanced condition until about the twentieth generation of the experiment. Thereafter a sudden increase in the frequency of the Arrowhead inversion occurred, followed by a steady climb until the end of the experiment. In the twenty-sixth generation chromosomes were sampled from the population and four new populations were made up. These new populations contained either reselected Arrowhead and Pikes Peak chromosomes, original Arrowhead and Pikes Peak chromosomes, or combinations of reselected and original chromosomes. The two cages started with reselected Arrowhead strands showed a much more rapid rise in the frequency of Arrowhead than the two cages containing original Arrowhead strands. The latter two populations showed the same changes as did the original experimental population. The conclusion is that genetic changes occurred within the Arrowhead gene pool causing Arrowhead to be more fit in homozygous condition. It is this improvement that was responsible for the loss of the balanced polymorphism.

LI, C. C. *See* LEWIS, JESSICA H.

LI, H. W. Cytological Studies of Sugarcane and Its Relatives XV: Basic Chromosome Number of *Saccharum officinarum* L. *Institute of Botany, Academia Sinica, Taiwan, China.*

The euploid number of *Saccharum officinarum* L. is 80. By crossing noblecane variety Vellai ($2n = 80$) to *Sclerostachya fusca* A. Camus ($2n = 30$), and by repeated back-crossing to the recurrent male parent, the chromosomes of sugarcane will be halved in each successive back-cross generation. Finally, in the third back-cross generation, only 10 sugarcane chromosomes are left in the hybrid along with 30 *Sclerostachya-Narenga* chromosomes. (The third back-crossing was done in Taiwan. *Narenga porphyrocoma* (Hance) Bor ($2n = 30$) was used instead of *Sclerostachya*.)

SG310/6 (B.C. 1) was found to have 72 chromosomes, 42 of which belong to sugarcane, the other 30 to *Sclerostachya*. This variety was obtained by back-crossing F_1 hybrid to *Sclerostachya*. Many PMC examined had 36 bivalents showing complete autosyndesis. The larger closed-type bivalents of *Sclerostachya* can be easily distinguished from the smaller open-type ones of sugarcane. One or two tetravalents were formed by the sugarcane chromosomes.

In the second back-cross generation clone SG363/4 was found to have 50 chromosomes. In the majority of the cases, 25 bivalents were found. Again the clone showed complete autosyndesis. One sugarcane tetravalent was sometimes found.

In the third back-cross generation, *Narenga* was used. Out of 15 plants 14 were found to have 40 chromosomes. (The one exception had 63.) There was almost perfect pairing between the chromosomes of *Sclerostachya* and *Narenga*, forming 15 closed-type bivalents. The 10 sugarcane chromosomes remained either as univalents or as 1–3 open-type bivalents. As many as 4 trivalents were found. It showed that 4 sugarcane chromosomes were partially homologous with 40 *Sclerostachya-Narenga* chromosomes. Sometimes, two tetravalents were found. These were composed of two sugarcane and two *Sclerostachya-Narenga* chromosomes.

From these data, it is conjectured that the ten sugarcane chromosomes are probably made up of two sets of five. Three chromosomes of each set are partially homologous to one another. At least four chromosomes of one set of five of one species are partially homologous to four of these from either *Sclerostachya* or *Narenga*. Initial hybridization between two unidentified species with $n = 5$, each leading to segmental allopolyploidy, and followed by two successive autopolyploidies, has probably resulted in the origin of *Saccharum officinarum* with 80 chromosomes.

LIEB, MARGARET. Relationships between Mutation, Phenotypic Lag and Protein Synthesis. *Brandeis University, Waltham, Mass., U.S.A.*

The yield of induced bacterial mutants is markedly influenced by culture conditions before and after UV irradiation. Experiments on a tryptophane-requiring (try—) strain of *Escherichia coli* B/r have shown that in exponentially growing broth cultures, protein synthesis is required for the expression of induced try+ mutants. Incubation of irradiated try— cells in broth containing chloramphenicol (CML) allowed DNA synthesis, a small amount of protein synthesis, and the expression of only a small fraction of the try+ mutants that appear in the absence of CML. When the CML-grown cultures were subsequently placed in broth without CML, the majority of the expected mutants appeared. Our findings do not confirm those of Witkin (Cold Spring Harbor Symposium XXI, 1956) who found that growth in CML permanently prevented the expression of induced try+ mutants. We believe that Witkin's results may be attributed to the fact that exposure to CML increases the time required by try+ mutants to initiate growth. When mutants are assayed on plates that also support the growth of try— cells, there is competition between mutants and non-mutants for protein precursors required by try+ for phenotypic expression.

In stationary phase cultures of try—, a large fraction of UV-induced mutations are expressed under conditions allowing no appreciable protein synthesis. This was not observed in exponential phase cultures grown in the same broth medium. The storage of intracellular precursors and their use in the synthesis of protein required for phenotypic expression may account for the observed "0-point" prototrophic mutants.

LIMA-DE-FARIA, A., PATRICIA SARVELLA, and ROSALIND MORRIS. Structural Differentiation of the Chromosome in Different Tissues. *Institute of Genetics, University of Lund, Lund, Sweden.*

Ornithogalum virens is a species with only three bivalents at pachytene. Chromosome I is the longest, chromosome II has a large knob, and III is the nucleolar chromosome.

In Diptera definite segments of the chromosome are known to show different structural features in different tissues. *O. virens* permits study of the same phenomenon in plants. Besides pachytene, the chromosomes can be identified at the prophase of the second microspore mitosis where they exhibit an equally distinct chromomere structure. Hence, the chromomeres of the same chromosome may be compared in different tissues. At pachytene, chromosome I has an average length of 109.0 microns and an average chromomere number of 105.3. At prophase of the second microspore mitosis this chromosome is 22.3 microns in length and, surprisingly, has only 24.3 chromomeres. The same relationship is true for the other chromosomes. The length decreases by about one-fifth at the microspore mitosis and the chromomere number decreases also by approximately one-fifth. The average distance separating the chromomeres at these two stages is approximately the same: 1.07 and 0.89 microns for pachytene and prophase of the second microspore mitosis respectively (analysis of the whole complement in 20 cells).

The knob of chromosome II which is very large at pachytene is, contrary to expectation on the basis of simple contraction of the chromosomes, very small at the microspore prophase and sometimes is not distinguishable. Two weakly stained segments in chromosomes I and II are also not easily recognizable at the microspore prophase. On the other hand chromosomes I and III show two large deeply stained segements at diakinesis which are not present either at pachytene or at the microspore prophase.

Definite segments of the same chromosome show different structural features in different tissues.

LINDEGREN, CARL C. Recombination in Bacteria. *Biological Research Laboratory, Southern Illinois University, Carbondale, Ill., U.S.A.*

Demonstration of Mendelian heredity requires that all the segregants of a hybrid fall into two equal contrasting classes representing the corresponding characteristics of the progenitors. Although the bacterial geneticist cannot recover all the progeny under his experimental conditions, he has assumed a 1:1 gametic ratio for every segregating character. The assumption that the phenotype represents the genotype involves the corollaries that (1) every change in phenotype is due to gene-change; (2) cytoplasmic inheritance does not occur in bacteria, and (3) recombination of phenotype is equivalent to recombination of genotype. To the bacterial geneticist "recombination" means "recombination of genes"; to the classical geneticist it means "recombination of phenotypes," from which it may or may not be correct to infer the recombination of genes. If the genotype can be identified by the phenotype, the phenomenon of Dauermodifikation first described by Jollos (1921) must be disregarded. An example of Dauermodifikation is supplied by the white variant arising from the pink yeast. A direct experiment in Saccharomyces on the stability of the heterozygous diploid carrying the genes for adenine-independence and adenine-dependence reveals that genes may be much more unstable in the heterozygous than in the homozygous condition. This phenomenon produces results resembling the recovery of prototrophs. Bacterial geneticists have inferred that the failure of their data to conform to the pattern of chromosomal behavior found universally in other organisms means that a new and different kind of chromosomal mechanism is present in bacteria. The failure of the data from bacterial genetics to fit the standard meiotic apparatus may not be due to a different kind of meiotic apparatus or even due to a different kind of hereditary behavior but may be connected with difficulties routinely encountered in all genetic analysis.

LINDSLEY, D. L., C. W. EDINGTON, and E. S. VON HALLE. Sex-Linked Recessive Lethal Changes in *Drosophila melanogaster* Suppressed by the Y Chromosome. *Biology Division, Oak Ridge National Laboratory, Oak Ridge, Tenn., U.S.A.*

Thirty-two sex-linked recessive changes that are lethal or semilethal as XO males but surviving as XY males were produced and studied in *Drosophila melanogaster*. They are divisible into three groups on the basis of their *bobbed* constitution and the fertility of X/Y males.

Six are deficient for factors in the proximal heterochromatin, including *bobbed*, and are fertile as X/Y males. None of these is associated with a translocation, and crossing-over in the X appears normal. These X's disjoin normally from their homolog during oogenesis, but five of them exhibit abnormal disjunction from the Y chromosome during spermatogenesis characteristic of X chromosomes deficient for proximal heterochromatin.

Ten of the altered X's are fertile as X/Y males and are not *bobbed* deficient. Six of the ten exhibit drastically reduced crossing-over, but only two are associated with translocations. The lethal changes appear to localize randomly on the X. These and additional observations that several exhibit variegated phenotypes and two survive as homozygous females led to the hypothesis that these are position-effect lethals.

The remaining sixteen altered X's, which may also be position-effect lethals, are sterile as X/Y males and are not *bobbed* deficient. Twelve are associated with X-autosome translocations. Their effect on crossing-over ranges from a quite severe reduction to nearly normal. These lethals tend to be located proximally on the X but are not limited to that region. Disjunction of these X's from their homolog during oogenesis is highly abnormal; when the second X is Muller-5, the incidence of primary non-disjunction is about 0.33. The curious correlation among male sterility, translocation, and abnormal disjunction is unexplained. The meiotic divisions of these males are normal; they seem to owe their sterility to abnormalities in spermiogenesis. Specifically, sperm head elongation is incomplete, but the degree is different for different stocks.

LINK, K. P. *See* BEDNEKOFF, A. G., *et al.*

LOPER, J. C. *See* HARTMAN, P. E., *et al.*

LOWRY, DOROTHY C., and I. MICHAEL LERNER. Stabilizing Selection for Shank Length Consequent on Directional Selection for Egg Production. *Poultry Husbandry Department, University of California, Berkeley, Calif., U.S.A.*

A line selected for long shanks was derived twenty years ago from a flock of Leghorns bred for egg production and viability (Heredity 5:75). Subsequent behavior of shank length in the egg production line is now being investigated with special reference to reproductive fitness.

It has been established that over an interval of several generations after the truncation of the foundation stock, its mean shank length regained a stable level although no conscious selection was practised for this character. Its variance remained unchanged from that in the original population. During this period artificial selection appears to have favored birds with shank length greater than the mean, excepting those exceeding the mean by three or more standard deviations. Thereafter, once the mean had become stable, artificial selection favored birds with intermediate shank lengths. The variance of birds selected for reproduction throughout the whole period of study was consistently smaller than that of their whole generation.

Differences in reproductive fitness of birds of varying shank lengths can be accounted for entirely on the basis of selection for egg production and viability. That is to say there was no natural selection for either intermediates or extreme shank lengths among dams chosen to reproduce the production-bred flock. This was not the case in the line selected for shank length, in which natural selection began discriminating against extremes after some generations of selection, an effect which disappeared after suspension of selection.

LYON, MARY F. Some Evidence concerning the "Mutational Load" in Inbred Strains of Mice. *Radiobiological Research Unit, Harwell, Didcot, Berkshire, England.*

In studies of the effect of external mutagenic agents on animals knowledge of spontaneous mutation is useful. It has long been known that not all the ova shed by a female mouse are represented by living young at birth, and it has usually been supposed that the embryonic elimination implied by this was largely due to an unfavourable uterine environment. However, Haldane in 1936 calculated, on the basis of certain assumptions, that the frequency of heterozygotes for recessive lethal genes in an inbred strain of mice should be approximately one.

If these assumptions were correct a large proportion of the embryonic death in inbred lines of mice would be due to the segregation of recessive lethals. To test this hypothesis reciprocal crosses were made within and between three inbred strains: CBA/H, C3H/H and 101/H. Pregnant females were dissected and the proportion of embryos which had died between the time of implantation and 13½–15½ days' gestation was noted.

In crosses within strains the rate of embryonic death was consistently higher than in crosses between strains, showing that a proportion of the deaths were "recessive" in type. It is suggested that these deaths are due to the segregation of recessive lethal genes which had arisen by mutation within the strain, and the results are compared with those expected on the basis of Haldane's calculations.

MacDonald, M. A. Seasonal Growth Relationships in Aberdeen Angus × Jersey Crossbred Cattle. *Experimental Farms Service, Canada Department of Agriculture, Lethbridge, Alberta, Canada.*

During the late winter of 1953 twenty-one calves sired by purebred Aberdeen Angus bulls and out of commercial Jersey cows were brought to Ruakura Animal Research Station. Bucket feeding commenced when calves were 2 days of age and each was fed according to Ruakura recommendations. At 8 weeks of age 7 bull calves and 4 heifers were weaned and the remaining 6 males and 4 heifers at 18 weeks. Males were castrated at ages ranging from 14 to 17 weeks. Growth rate was measured by live weight gain and anatomical measurements until the animals reached 30 months of age. Data were analysed by Doolittle's method of least squares analysis, Brody's method for determining instantaneous growth constants and analysis of variance. The following results were obtained. (1) Steers gained 133 pounds more than heifers during the 30 month experimental period. This difference was highly significant ($P < .01$). (2) Age at weaning did not affect weight gain during either the first year or the entire experimental period. (3) Growth rate, measured by instantaneous growth constants for growth periods between ages of 1 and 52 weeks, decreased steadily with age for all groups. (4) Growth rates of all groups of crossbreds equalled that of purebred Aberdeen Angus cattle at Ruakura and exceeded that of range beef steers in Texas and feedlot steers fed a moderate T.D.N. ration in Missouri. (5) Anatomical measurements indicated that the period of pasture shortage during the second year did not suppress skeletal growth but did suppress liveweight gain and degree of fill. (6) Variation in liveweight within seasons and within groups was sufficiently large to prevent expression of statistically significant growth relationships between seasons. Relative seasonal gains could not be predicted.

On the basis of this and other studies, crossbred calves for veal and liveweight beef production are recommended. If a pasture shortage necessitates a reduction in numbers carried beyond the veal stage, steers should be selected preferentially for retention.

MAGNI, G. E. Effect of Natural Selection on a Cytoplasmic Character in *Drosophila bifasciata. Istituto di Genetica, Università, Pavia, Italy.*

In *Drosophila bifasciata* the character "sex-ratio" is transmitted maternally and is due to extra chromosomal determinants. The frequency of "sex-ratio" females found in nature suggested the hypothesis that the permanence of the cytoplasmic character in natural populations can be assured by a selective advantage of the s.r. individuals over the normal ones. The behaviour of such character has been, therefore, studied under severe natural selection pressure in laboratory populations in which s.r. females were in competition with normal flies.

S.r. individuals under our experimental conditions show a definite selective advantage which causes a progressive decrease in the proportion of normal flies until these are present in approximately 10% of the population. After several generations, however, the trend is reversed and the relative number of normal females increases considerably. An analysis of these populations showed that the variations in the frequency of the s.r. females are due to evolutionary changes occurring both in the genotype and the cytoplasm and resulting in different equilibrium values at different times.

MAINX, F. Population Genetics of *Drosophila* Species on the Liparic Islands. *Institut für Allgemeine Biologie der Universität Wien, Vienna, Austria.*

In 1956–7 research was carried out on the influence of insular isolation on the genetic structure of *Drosophila* populations on the Liparic Islands in the Thyrrenean Sea. The distribution of some species of the genus is in accordance with the warm climate of the Mediterranean, but compared with results on the continent shows disparities caused by isolation.

One main subject was concerned with the frequency and the allelism of recessive lethals in II-chromosome of *D. melanogaster*, studied by crossing wild males with a stock Pm/LCy. The frequency of lethals is approximately the same in spring and in autumn, about 25%. This figure is low compared with continental populations, for instance, Palestine with 32%, Florida with 60% lethals in II-chromosome. The degree of allelism was about 0.72% in autumn and in spring as much as about 2.38%. These figures are high compared with continental statements, for instance 0.33% in Florida, 0.34% in autumn and 0.83% in spring in Palestine. Although these figures are not yet final, the differences are significant.

Another subject was the chromosomal polymorphism of *D. subobscura.* Qualitatively there are some differences from the populations in Central Europe. The degree of structural heterozygosity seems to be no smaller than in continental populations. The effect of heterosis is so powerful that it keeps up a high degree of heterozygosity against the genetic drift.

MAJUMDER, S. *See* BREWBAKER, J. L.

MAKINO, SAJIRO. Alteration of the Stemline Chromosomes in Transplantable Ascites Tumors of Rats. *Zoological Institute, Hokkaido University, Sapporo, Hokkaido, Japan.*

The chromosome cytology of transplantable ascites tumors in rats and mice have afforded available data which support the reality of the stem-cell hypothesis that each neoplastic population contains a characteristic stem-line (or lines) of tumor cells which function as the primary contributors to the neoplastic growth maintaining the genetic pattern of each tumor. The tumor cells most frequently occurring with characteristic chromosome number-mode together with a specific ideogram form a stem lineage (or lineages). Each tumor is clearly distinguishable from others, as well as from the ordinary tissue, by its stemline ideogram (or ideograms).

The drastic applications, cold storage, heteroplastic transplantations and some other experimental procedures have generally failed to induce any change of either the stemline ideogram or its genotype. In the light of the recent investigations, however, it has been shown that the stability of the stem-line, while it is very pronounced, is not always permanent, and tends to undergo transition after its origin during serial transfers with the rise of a new type of tumor. The shifts may involve structural rearrangements and other adjustments of the stemline chromosomes. If such a type of cells newly arisen were superior in competitive ability to the population of original type of cells, the cell population as a whole would shift into the new cell type after several generations of selections, and such changes will produce a change of the genotype of the tumor with the shifts in its property. It is interesting that the rise of a new type of the tumor takes place in close association with alteration of the stemline chromosomes.

MALOGOLOWKIN, CHANA, and D. F. POULSON. Sex-Ratio in *D. willistoni* and *D. paulistorum. Faculdade Nacional de Filosofia, Universidade do Brazil, Rio de Janeiro, Brazil,* and *Department of Zoology, Yale University, New Haven, Conn., U.S.A.*

Abnormal "sex-ratio" in *Drosophila* was first reported by Magni (Inst. Lombardo Sci. Lett. *75*:3–23) in *D. bifasciata* and by Cavalcanti and Falcao (Caryologia *6*:1233–5) in *D. prosaltans.* It is transmitted from mothers to daughters in the form of progenies consisting mainly, or exclusively, of females. When crossed to males from a variety of strains giving normal proportions of the sexes, "sex-ratio" females continue to produce mainly daughters. Similar cases of "sex-ratio" have been described by us in *D. willistoni* and in *D. paulistorum* (Malogolowkin & Poulson, Science *126*: 32; Malogolowkin, Genetics, in press). These two species are widely distributed geographically, being abundant in South and Central America (Dobzhansky, Burla & Cunha, Amer. Nat. *84*: 229–46; Dobzhansky, Evolution *2*: 280–93). Although large numbers of individuals have been collected over a period of years these are the first instances of "sex-ratio" in these sibling species.

Single females each of *D. willistoni* from Jamaica and of *D. paulistorum* from Colombia gave rise to "sex-ratio" strains which were shown to carry a cytoplasmic factor responsible for the condition (Malogolowkin, 1958). The original progenitors of these "sex-ratio" strains evidently carried genes favorable to the multiplication of the cytoplasmic agent which leads to the death of all XY zygotes bearing it and so brings about the unisexual progenies. This is also true of certain laboratory strains to which "sex-ratio" females were mated. However, in matings with males of strains from certain different localities the "sex-ratio" effect was reduced, and after a few backcrosses to such males, the normal proportions of sexes appeared. In such cases the cytoplasmic agent is irreversibly lost, just as *kappa* in *Paramecium aurelia* (Sonneborn, 1943) disappears in the unfavorable genotype.

To determine whether as in the case of the CO_2 sensitivity factor in *D. melanogaster,* (L'Heritier & De Scœux, Bull. Biol. France Belg. *80*: 171–227) the "sex-ratio" agent of *D. willistoni* might be transferred by injection into other strains we carried out a series of injections of ooplasm from the abnormal male zygotes into the abdomens of young virgin females of normal strains (Malogolowkin & Poulson, Science *126*: 32; Malogolowkin, Poulson & Wright, Genetics, in press). Transfer was accomplished and "sex-ratio" has been established even in a strain genotypically resistant to the cytoplasmic agent. Injection of "sex-ratio" ooplasm into adult males is always lethal within a few days. Available evidence suggests that the "sex-ratio" agent is limited to the female germinal line.

MANGELSDORF, PAUL C. A Genetic Reconstruction of the Ancestor of Maize.

Botanical Museum, Harvard University, Cambridge, Mass., U.S.A.

Recent studies of fossil maize pollen from the Valley of Mexico and of prehistoric maize cobs from once-inhabited caves in Mexico, New Mexico, and Arizona indicate that the ancestor of cultivated maize was a form of pod corn with small ears, bearing tiny seeds enclosed in glumes. In an attempt to reconstruct this ancestor by combining primitive characteristics still existing in cultivated maize, pod corn, which has covered seeds, was crossed with pop corn which has small ears and seeds. The maize produced by this hybridization not only has several of the principal characteristics found in the prehistoric maize, but it also exhibits other traits which are probably ancestral. The genetically reconstructed ancestral form is a many-stalked plant bearing its ears in the higher, more slender regions of the stalk which can support only small ears. Ears borne at these high positions have few husks and these often flare open at maturity allowing the exposed ear to disseminate its small chaff-covered seeds. Both ears and tassels bear both male and female flowers and in this respect resemble the inflorescences of *Tripsacum*, a wild relative of maize.

In the course of evolution under domestication an ancestral form of this type has changed in several ways to produce the cultivated maize plant of today: (1) the many-stalked plant has become single stalked; (2) the ear has changed its position to a lower and stronger part of the stalk which is capable of bearing larger and heavier ears; (3) in this lower position the ears bear only female flowers and produce only grain; (4) in this lower position the ear has more numerous husks and is completely enclosed by them; (5) the covering of the individual grains has been lost.

Most of these evolutionary changes, which render modern maize unique among the cereals in its botanical characteristics, are in part the product of a single mutation at the *Tu* locus on chromosome 4.

MANN, T. J. *See* MATZINGER, D. F.

MANNA, G. K., and S. G. SMITH. Adaptive Chromosomal Polymorphism and Inter-Relationships among Bark-Weevils of the Genus *Pissodes* Germar. *Forest Insect Laboratory, Department of Agriculture, Sault Ste. Marie, Ont., Canada.*

Examination of males and females of 11 North American species of *Pissodes* has established the following diploid chromosome numbers: *strobi, engelmanni,* and *sitchensis* = 34; *approximatus* and *canadensis* = 30 — 34; *affinis, dubius, fasciatus,* and *radiatae* = 30; *yosemite* = 28; and *terminalis* = 28 (♀) and 29 and 32 (♂). The variation in chromosome number is chiefly due to changes ("fused" *versus* "unfused") in the 3 largest pairs of chromosomes, which are labelled A, B, and C. Thus in *yosemite* the first spermatocyte metaphase contains 3 large bivalents usually as rings, the 30-chromosome group has 2 rings, while there are no rings in the 34-chromosome group other than the asymmetrical one formed by the X and Y in all species.

Extreme intraspecific chromosomal polymorphism has been encountered in *approximatus* and *canadensis.* About 570 adults, mostly males, of *approximatus* from different localities in Ontario have shown the 9 karyotypes expected as a result of heterozygosity for the A and B fusions. The population frequencies suggest that (single and double ??) fusion homozygotes are better adapted than other polymorphs. In *canadensis* it appears, from 62 adults studied, that in some populations of Manitoba the reverse is true. Further, in both species, a medium-sized heteromorphic autosomal bivalent is occasionally found.

Presumably *terminalis* can be heterozygous for A, B, and C fusions, but surprisingly, instead of the expected 27 polymorphs, 49 of the 50 males examined were heterozygous for A and homozygous for fusions B and C, the fiftieth ($2n = 32$) being heterozygous for both A and B and homozygous for unfused C.

A detailed analysis of the karyotypes and their frequencies in natural populations has been made and the evolutionary significance is discussed.

MANUNTA, CARMINA. Biochemistry and Genetics in Silkworms (*Bombyx mori*): Chromatographic Patterns and Nitrogen Metabolism. *Istituto di Biologia e zoologia generale, Università Sassari, Sassari, Italy.*

Substances which are fluorescent in ultraviolet light are present in the cocoons of silkworms and in their eggs, larvae and pupae. Some of these substances are derived from the food—mulberry leaves for *Bombyx mori,* and ailanthus for *Philosamia cynthia*; some others appear to be endogenous.

Paper chromatography, applied to the pupae of *Bombyx* of several races, shows sharp racial differences in the series of spots: 4–9 in ammonium propanol, and 6–12 in acetic butanol.

Notwithstanding great individual variability inside each strain, we can recognize three groups of strains exhibiting complete, incomplete, or intermediate fluorescent patterns. In many strains a differential pattern has been observed in the two sexes; and comparison between patterns in extracts of pupal body and caecum (excretory ampulla) and several layers of the silk cocoon shows a differential distribution of the fluorescent material. The injection of silkworms of many breeds with four synthetic pterins has shown, in a few strains, a differential migration from blood to silk for each fluorescent substance introduced, single or mixed: especially for xanthopterin and leucopterin.

The application of chromatographic methods—on cellulosa column and on paper—to a mass of cocoons of several breeds of *Bombyx* has effected the separation of many fluorescent substances—no less than thirty—from the silk. For eight of these it has been possible to determine the absorption curve in ultraviolet light. It is very characteristic—unlike those obtained for natural or synthetized pterins—and points to four different chemical groups, at least. While chemical identification is considered an important task for future researches, investigations are under way on the specific differential permeabilities and their Mendelian behaviour as a connecting link between previous researches on physiogenetics of pigments and nitrogen metabolism.

MARCOU, DENISE. Sur le déterminisme de la sénescence observée chez l'Ascomycète *Podospora anserina. Faculté des Sciences de Paris, Laboratoire de Génétique, Paris, France.*

Les souches de l'ascomycète *Podospora anserina* cultivées dans des conditions où leur croissance est continue n'ont pas une longévité infinie. Après un temps où la croissance est constante, celle-ci diminue rapidement, l'allure du mycelium devient anormal, la croissance s'arrête et les extrémités des filaments meurent. On dit que la souche est sénescente.

Toutes les souches meurent ainsi, mais elles peuvent avoir des longévités très différentes (de quelques jours à plusieurs années). La longévité de chaque souche peut être représentée par une courbe, caractéristique de chaque souche dans des conditions données, mais dont l'allure générale est toujours la même: un palier plus ou moins long suivi d'une droite descendante à pente variable.

La longévité d'une souche dépend de nombreux facteurs: température, éclairage, richesse du milieu de culture, génotype.

L'origine cytoplasmique de la sénescence a été mise en évidence par la technique des croisements réciproques. La sénescence peut en effet être transmise aux descendants, par l'élément femelle et par lui uniquement. Par ailleurs, on n'observe de ségrégation du caractère ni dans l'asque, ni même dans le périthèce.

Des expériences de micromanipulation ont confirmé ce résultat. La sénescence se révèle infectante par anastomose bien que sa propagation dans un hyphe soit assez lente. Or on sait que chez cet organisme les anastomoses permettent un échange uniquement cytoplasmique entre les hyphes.

Une hypothèse particulaire peut rendre compte de ces résultats. Il peut s'agir soit de la multiplication anormalement rapide d'un élément normal de la cellule, soit de la multiplication d'un élément n'existant pas sous cette forme dans les souches normales.

MARCOVICH, HERBERT. Recherches sur la mutabilité spontanée d'*Escherichia coli* B. *Laboratoire Pasteur de l'Institut du Radium, Paris, France.*

L'étude du mécanisme de la mutabilité spontanée chez les bactéries est génée par la présence de nombreux mutants dans le milieu de culture. En utilisant la technique de Davis à la pénicilline il est possible dans une population de bactéries auxotrophes de faire décroître considérablement le taux des prototrophes. Ainsi, sur

la souche d'*Escherichia coli* B h^- qui a besoin d'histidine comme facteur de croissance le taux des h^+ qui varie normalement entre 10^{-7} et 5.10^{-7}, peut être amené à une valeur inférieure à 10^{-9}. Il est allors possible de déceler avec précision l'apparition de prototrophes nouveaux.

Cette technique a été appliquée à l'étude de la mutabilité de bactéries dans un état de non-prolifération.

Les princiaux résultats suivants ont été acquis. (1) Aucune mutation nouvelle n'apparait si les bactéries sont gardées à l'état congelé à —25°C ou à l'état liquide vers +2°C. (2) Aucune mutation nouvelle n'apparait si les bactéries sont incubées à 37°C dans un milieu minimum dépourvu de source d'énergie (glucose). (3) Des mutations apparaissent à 37°C en présence de glucose à un taux de l'ordre de 10^{-9} prototrophes par bactérie et par heure. La mortalité dans nos conditions expérimentales est nulle.

Ces résultats sont discutés.

MARTIN, G. A., and A. E. BELL. Response to Selection for Adult Weight and Observed Changes in Reproductive Fitness in *D. melanogaster*. *Poultry Science Department, Purdue University, Lafayette, Indiana, U.S.A.*

From each of 2 independent samples drawn from a synthetic population (synthesized from 12 inbred lines) of *D. melanogaster*, a large and a small adult body weight line was selected for 15 generations. As Falconer observed in mice (J. Genet. *51*: 470–501), response to selection was asymmetrical toward small body weight in the early generations. The early asymmetry was partially reversed by rapid progress in the large lines during the mid-portion of the experiment. All lines showed decreased response after generation eleven. The coefficients of regression of body size on generation of selection for generations 1–6, 5–11, and 10–15, respectively, were +1.78, +17.69, +7.19 and +16.24, +19.35, +17.35 μg. for the two large lines and —29.92, —13.62, —11.20 and —10.93, —11.90, —7.48 μg. for the two small lines.

Daily egg production, length of eggs in micrometer units of microscope eyepiece, and percentage of eggs producing adults were measured for each of the lines as functions of reproductive fitness. The coefficients of regression of egg production on generation of selection were —5.77, +.71, —1.19 and —3.35, —1.08, +.33 eggs (for generations 1–6, 5–11, 10–15 respectively) for the large lines and —8.37, +2.47, +2.61 and —2.54, —3.45, —2.02 eggs for the two small lines. The coefficients of regression of egg length on generation were —.13, —.05, —.09 and —.08, +.03, —.05 units for the two large lines and —.41, —.07, —.24 and —.05, —.22, —.14 units for the two small lines. Coefficients of regression of percentage of eggs producing adults were —2.01, —1.34, +1.27 and —5.37, —2.79, —3.11% for the two large lines and —4.88, —.07, —1.80 and —.81, —4.48, —.65% for the two small lines.

The fact that all lines have negative regressions for the three fitness traits during generations 1–6 while body size was moving in opposite directions, indicates that neither pleiotropy nor tight linkage of genes influencing body weight and the other traits have paramount effects in these populations. The role of inbreeding will be presented. (This work was supported by grants from the Rockefeller Foundation and the National Science Foundation.)

Matsui, Tetsuo. *See* Smith, Jimmie B.

Matsumoto, Kenzo. Morphology of *Aegilops* F_1 Hybrids with Reference to Genome Differentiation. *Biological Laboratory, Department of Natural Sciences, Osaka University of Liberal Arts and Education, Tennoji, Osaka, Japan.*

In relation to the genome constitutions, various ear characters have been studied morphologically in *Aegilops* F_1 hybrids of about 90 different combinations. The ear characters were color, shape, type of articulation, rudimentary keel of empty glume, hairiness on glumes, and number of awns or teeth of lateral and apical spikelets.

In nine diploid species, or analysers after Kihara (1954), the respective characteristics correspond to the respective genomes, while in the tetraploids their specific characteristics are controlled by the second genomes involved in combinations with those of the analysers, and similarly for the third genomes of the hexaploids.

Based on the present studies it will be shown that the second genomes of the tetraploids are morphologically more differentiated than those of the analysers, but the third genomes of the hexaploids show little or no differentiation.

Details will be discussed in regard to each of the above-mentioned items of the ear characters.

Matsumura, S., M. Muramatsu, and S. Sakamoto. Genome Analysis in *Agropyron*, a Genus Related to *Triticum*. *National Institute of Genetics, Misima, Japan.*

The genus *Agropyron* comprises three sections, *Euagropyron*, *Elytrigia* and *Roegneria*. Intrasectional hybrids are easily obtained, but intersectional crosses are difficult. Hybridization experiments with *Triticum* and *Agropyron* showed that the easiest crosses were those between the Emmer or Dinkel group and section *Elytrigia* and it was difficult to obtain a hybrid between the latter and the Einkorn group, while crossing of *Triticum* with *Roegneria* was unsuccessful. In the sterile F_1 between *A. glaucum* (= *A. intermedium*, EEFFJJ) and several Emmer species (AABB) varying chromosome conjugations $3_{II}+29_{I}\sim 12_{II}+11_{I}$ (mode, $(7\text{–}8)_{II}$) were observed. The F_1, *T. Timopheevi* (AAGG) × *A. glaucum*, was completely sterile and showed various conjugations $2_{II}+31_{I}\sim 8_{II}+19_{I}$ (mode, 5_{II}). In the sterile F_1 between *A. glaucum* and two Dinkel species (AABBDD) various kinds of conjugation $2_{II}+38_{I}\sim 13_{II}+16_{I}$ (mode, 6_{II} & 11_{II}) were found. Crossing of *A. glaucum* with *Aegilops longissima* (S^1S^1), *Ae. cylindrica* (CCDD) and *Ae. variabilis* ($C^uC^uS^vS^v$) was successful. All hybrids were completely sterile and showed various kinds of conjugation, namely, $1_{III}+5_{II}+15_{I}\sim 10_{II}+8_{I}$ (mode, 8_{II}) in the hybrid with *Ae. longissima*, and $5_{II}+25_{I}\sim 10_{II}+15_{I}$ (mode, 6_{II} & 8_{II}) in the hybrids with the tetraploid species. Judging from the occurrence of six to eleven bivalents in these hybrids, allosyndesis of several chromosomes between the genomes of *Triticum* or *Aegilops* and those of *Agropyron* may be assumed, which might for the most part belong to the *Triticum* B- or *Aegilops* S-genome, partially homologous with the J-genome of *A. glaucum*. Moreover, the possibility of autosyndesis of several chromosomes between the genomes of *A. glaucum* is indicated.

According to the hypothesis of McFadden and Sears (1946), *A. triticeum* should have the B-genome. It is well known that all chromosomes of the B-genome in *Triticum* have median or submedian constriction. But all seven chromosomes of *A. triticeum* show subterminal centromeres, while the diploid *A. elongatum* and *A. cristatum* have chromosomes with median or submedian constriction.

MATZINGER, D. F., T. J. MANN, and H. F. ROBINSON. Estimates of Genetic Variability in Flue-Cured Varieties of *Nicotiana tabacum*. *North Carolina State College, Raleigh, N.C., U.S.A.*

Little evidence has been accumulated on the type and magnitude of genetic variance in *Nicotiana tabacum*. Previous estimates of sizable amounts of additive genetic variance but little dominance variance were obtained under the assumption of no epistasis. A cross between C139, a high yielding variety, low in flavor and aroma, and Hicks, intermediate in yield and of good quality, was studied for the nature of the inheritance of certain agronomic and chemical characters. Eight F_2 plants were assigned at random to a set, four being designated as male parents and four as female parents. Each male was crossed to each female making a total of 16 crosses per set, and all parent plants were selfed to give 8 F_3 families. The progenies of crosses from 10 of these sets were evaluated with each set comprising a block in the field with replication within a block. From a comparison of variances of the intercrosses and the selfed progeny, and from the covariance of F_2 plants in crosses versus selfed progeny performance, estimates of additive genetic, dominance, and additive × additive epistatic variances were obtained under the assumption of no other types of epistasis. Characters for which data are available include leaf yield, value per acre, value per 100 pounds, date to first flower, plant height, number of leaves, number of suckers, length of largest leaf, width of largest leaf, and percentage of nicotine. Predicted genetic advance is considered from selecting the superior full-sib families and intercrossing to create the next generation of material.

MAYNARD SMITH, J. The Genetics of Longevity in *Drosophila subobscura. Department of Zoology, University College, London, England.*

Adult life span of *Drosophila subobscura* at 20°C has been measured for nine inbred lines, for two kinds of F_1 hybrids between inbred lines, for the F_1 from wild females caught in southern England, and for the F_1 and F_2 from wild females caught in Galilee.

There were large differences between inbred lines, but most inbred populations had a lower mean life span than outbred ones, and were more variable not only than the F_1 hybrids but also than the populations derived from wild females.

Significant sex differences in longevity were found in six of the nine inbred lines, in one of the two F_1 hybrids, and in the Galilee population. In all, four sex differences in each direction were found. This shows the importance of genes with sex-limited effects on longevity, i.e., with different effects on males and females.

In the Galilee population, correlations between relatives of the same sex were higher than between relatives of unlike sex, suggesting that genes with sex-limited effects were responsible for an appreciable part of the differences between families in the Galilee population.

Females which have no ovaries, or which are unmated and so lay fewer eggs, or which are kept at 30.5°C soon after emergence for a period of days sufficient to cause regression of the ovaries live longer than do normal mated females. Thus in females the rate of ageing depends on the rate of egg-laying. It follows that the causes of ageing are in part different in the two sexes, and it is therefore not surprising to find that genes with sex-limited effects on longevity are important.

MAZOTI, LUIS B. Inherited Preferential Somatic Segregation in *Zea* Conditioned by the Cytoplasm. *Instituto Fitotécnico de Santa Catalina, Buenos Aires, Argentina.*

The pure line carrying teosinte cytoplasm, genotype pl/pl (no anthocyanin) was backcrossed four times to the genotype PL/PL (anthocyanin bearing) carrying *Zea* cytoplasm: 86 individuals resulted, 37 of which were of the genotype Pl/pl and 49 PL/PL. Theoretically, we would have obtained 5 heterozygotes and 80 homozygous dominants (15:1 ratio). The heterozygote PL/pl backcrossed to the homozygous recessive should have given a ratio of 1 PL:1pl. The actual values were PL 1,022 and pl 1,296. This discrepancy suggests a preferential segregation. To eliminate the possibility of a point mutation the line in question was backcrossed using a genetic marker sm (salmon-coloured stigma) located 10 map units from pl. In the backcross PL/pl sm/sm × pl/pl sm/sm, we obtained 99 PL/sm: 8 PL/sm: 11 pl/sm and 125 pl/sm with an excess of pl associated with gene sm. These results would indicate that this is not a point mutation.

The homozygous dominant PL/PL in *Zea* cytoplasm was backcrossed using the same genetic marker as before. In contrast, no excess of pl from the expected 1:1 ratio was obtained indicating that the cytoplasm is responsible for preferential segregation. In addition, heterozygous plants PL/pl on teosinte cytoplasm showed mosaics with non-purple regions in the panicle. The pollen from these regions was used to pollinate plants (pl/pl genotype) with the following ratio obtained, 77 pl/pl: 54 PL/pl. When pollen from purple regions was used, the ratio obtained was 22 pl/pl: 27 PL/pl. This sporadic instability which has been seen previously in this homozygous line (introduced to the Argentine from Cornell University, U.S.A.), and the high frequency of small mosaics in the anthers which would show sterile pollen when the heterozygous genotype was introduced into teosinte cytoplasm, point to a more complex hypothesis which requires cytological studies for its elucidation.

MCDONALD, DANIEL J. A Study of Mutations affecting the Viability of *Tribolium confusum. Department of Biology, Dickinson College, Carlisle, Pennsylvania, U.S.A.*

Two new mutations of *Tribolium confusum* have been isolated which have an adverse effect on viability. The first of these, designated "split" (abbreviated *sp*), was obtained from an inbred line of *Tribolium confusum.* It is an autosomal recessive which, in the homozygous condition, shortens and separates the elytra, exposing the posterior third of the abdomen. The expression of the gene does not seem to be dependent upon the degree of inbreeding. The fertility of the mutants is lowered as indicated by a high percentage of infertile pair matings (about 37%), and the viability is calculated to be about 88%. It is possible that the decreased fertility may simply be the result of inbreeding, but this has not been determined.

The second mutation, designated "Striped" (abbreviated *St*), is the first instance of a sex-linked lethal mutation to be reported in *Tribolium confusum*. This mutation, which appeared in a black strain of *confusum*, modifies the pigmentation of the elytra. In heterozygous females, a white stripe runs lengthwise along each elytron which is ordinarily solid black. In homozygous mutant females and males, the entire elytra is white. These males and females are completely nonviable and the females seem to be almost completely sterile. Heterozygous females, on the other hand, are viable and fertile. The viability of the white males and females is about 14%. Characterizing mutant beetles is beset by two difficulties. First, the stripes tend to fade and become almost indistinguishable after two weeks. Second, white individuals will occasionally have a small median strip of pigment and might be mistaken for striped beetles.

McGinnis, R. C., and A. B. Campbell. Fertile Triple Monosomics from a *Triticum vulgare* Cross. *Cereal Breeding Laboratory, University of Manitoba, Winnipeg, Man., Canada.*

A cross between a nullisomic and normal wheat plant usually produces only monosomic progeny. However, of eight plants from the cross, Redman nullisomic XXI × Prelude, only one plant was monosomic ($20^{II}1^{I}$), two were double monosomics ($19^{II}2^{I}$), while five were triple monosomics ($18^{II}3^{I}$). All the deficient plants were vigorous and partially fertile. Furthermore they were almost as tall and early as the normal Redman-Prelude hybrids having 21^{II}.

Ten F_2 plants from each of one selfed double and three selfed triple monosomics were grown and cytologically analysed. In general, the parental chromosome constitution predominated. Fertility counts were made on all F_2 plants. The monosomics averaged 62% fertility (ranging from 46–81%); the double monosomics averaged 38% (ranging from 1–73%); and the triple monosomics averaged 23% (ranging from 0–39%). One F_2 plant from a triple monosomic parent was doubly monosomic and singly nullisomic ($18^{II}2^{I}$), indicating that both male and female chromosome-deficient gametes functioned. This plant also appeared normal in growth and had 24% fertility, approximating the triple monosomic average.

An F_3 population from high- and low-fertility representatives of each deficient F_2 class was analysed. It was observed that the progeny tended to approach the full 21^{II} chromosome complement, although parental chromosome constitutions occurred with sufficient frequency to permit maintenance of the deficient stocks.

McLaren, Anne, and Donald Michie. An Effect of the Uterine Environment upon an Inherited Skeletal Character in the Mouse. *Royal Veterinary College, University of London, London, England.*

The number of lumbar vertebrae in the mouse is known to be under genic control. The same character shows a strong matroclinous tendency in reciprocal crosses between contrasting types. Using the technique of fertilised egg transfer, we have shown that the maternal effect is mediated through the uterine environment rather than through the cytoplasm of the egg. The only character previously known in any mammal to be affected by the uterine environment is body size. Number of lumbar vertebrae in mice is not related to body size, and the uterine influence cannot therefore be a simple nutritional one. Further work is planned to see whether the effect persists, as a kind of "somatic inheritance," for more than one generation.

MECHELKE, FRIEDRICH. The Timetable of Physiological Activity of Several Loci in the Salivary Gland Chromosomes of *Acricotopus lucidus. Institut für Kulturpflanzenforschung der Deutschen Akademie der Wissenschaften zu Berlin, Gatersleben, Germany.*

The salivary gland of the chironomid *Acricotopus lucidus* consists of 3 lobes: anterior, lateral and main. The secretion of each lobe is specific, as indicated by differences in the colour and consistency of the saliva. Every cell of the gland contains in its nucleus 3 giant chromosomes, which are easily distinguished by their patterns of bands. There are 12 distinct loci in the set of chromosomes, which are able to form puffs and balbiani-rings. The formation of such a functional structure indicates that the said locus is in full activity of genephysiological metabolism. If the structures of these 12 loci in the chromosomes of the various lobes during the development from the fourth larval instar through the prepupal to the young pupal stage are compared, it is obvious that each locus is not activated in each lobe and that the duration of activity is not simultaneous for all the loci. Owing to the specifically structural variations and changes of each locus, it is possible to present a detailed timetable of their physiological activity. In the anterior lobe especially the structural changes of the activated loci and the qualitative changes of the saliva produced demonstrate strikingly the parallel relations between the activity of loci and the specificity of metabolism.

The phenomenon of local and temporal limited formation of puffs and balbiani-rings may be considered as an enlargement of surface by unfolding the submicroscopic structure of the locus concerned. The unfolded surface represents the basis for catalytic reactions by which the genes deliver their specific products to the cell-metabolism. There are some parallel features between functional structures of giant chromosomes and interphasic structure of mitotic chromosomes. Characteristic for both is the enlargement of surface during the period of greatest metabolic activity.

MEHL, H. G. *See* EHLING, U.

MELACRINOS, A. *See* PRIADCENCU, AL., *et al.*

MELBER, D. *See* PRIADCENCU, AL., *et al.*

METTLER, LAWRENCE E., and MICHAEL A. BENDER. Chromosome Studies and Their Evolutionary Significance in New World Primates. *Department of Biology, The Johns Hopkins University, Baltimore, Maryland, U.S.A.*

It is generally agreed that the infraorder Platyrrhinae (New World monkeys) are composed of 2 families; Cebidae and Hapalidae. The Hapalidae may be divided into 2 sub-families; Hapalinae and Callimiconinae. Karyotypes have been obtained for 7 of the 9 genera of Cebidae, and preliminary studies made on the other 2. Karyotypes have also been obtained for a representative marmoset and a representative tamarin from the Hapalinae. Preliminary studies have been made on *Callimico*, the only genus in the Callimiconinae. Cytological observations were made on tissue-cultured somatic cells. Some observations were also made on bone marrow to verify the reliability of tissue-cultured material for cytological investigations. The highest diploid number found in Cebidae was 54 (genus *Cebus*), the lowest 34 (genus *Ateles*). In general, species with high chromosome numbers have a greater number of telocentric chromosomes; those with a low number have fewer telocentrics. Thus *Cebus* has 14 pairs of telocentrics, *Ateles* only one, excluding the sex chromosomes. The morphology of the X-chromosome varies as to size and position of the centromere in different species. The Y-chromosome is typically a very small telocentric. Species with low chromosome numbers (e.g., *Ateles*) are generally considered more specialized, those with high chromosome numbers (e.g., *Cebus*) less specialized on morphological and ecological criteria. It is proposed that a basic diploid chromosome number (in excess of 50) occurs in the Platyrrhinae. Chromosome evolution in the New World primates appears to have involved an alteration of the basic complement by such mechanisms as centric fusions and pericentric inversions, and has not involved polyploidy.

(This work was supported by a research grant from the National Science Foundation to Professor Wm. L. Straus, Jr. and by an Atomic Energy Commission contract with The Johns Hopkins University.)

METTLER, L. E. *See* GLASS, BENTLEY.

MEYER, HELEN UNGER. Modification of the Ultraviolet-Induced Rate of Autosomal Lethals by Nitrogen Pre-Treatment or Post-Treatment in *Drosophila*. *Department of Zoology, Indiana University, Bloomington, Ind., U.S.A.*

The influence of anoxia on ultraviolet mutagenesis in non-dividing embryonic germ cells (pole cells) of *Drosophila melanogaster* was studied in a series of experiments, in which part of the material was placed in an atmosphere of nitrogen for short periods, either as pre-treatment (lasting 5–12 min.) or as post-treatment (25 min.). A dose of 90 ergs/mm.^{2} of predominantly 2,537 Å was given simultaneously to all lots in each experiment, in all cases in air.

The rate of autosomal lethals (chromosome 2) was used to measure the genetic effects. Data from the various experiments in each series were summarized by the harmonic mean method designed by Muller (1941, 1952, and unpublished) for such purposes. The lethal rates given are these harmonically weighted mean mutation rates, and the average number of tested chromosomes listed are "effective" means applying to each of the contrasted groups. The rate obtained from ultraviolet without nitrogen treatment is listed first in each of these comparisons.

Giving a nitrogen post-treatment as late as 15 to 20 min. after ultraviolet irradiation did not influence the lethal rates: 5.6 ± .9% as compared to 5.9 ± 1.1% for the group getting the delayed post-treatment, with a mean effective number of 1,363 tests in each lot. When post-treatment followed irradiation within about a minute, a somewhat lower frequency for the nitrogen post-treated group was obtained: 5.3 ± .8% versus 3.0 ± .6% (2,082 tests each). However, the opposite trend became apparent when the nitrogen treatment immediately preceded irradiation, leading to a significant increase of the lethal rate in the pretreated group: 4.5 ± .7% against 9.0 ± 1.6%, with 1171 effective tests for each.

We conclude that our earlier results (1952, 1953), showing increase of ultraviolet mutagenesis when anoxia was applied both before, during and after the irradiation, represented the predominant effect of the pre-treatment by anoxia.

(This work has been supported by a grant to Dr. H. J. Muller and associates from the U.S. Atomic Energy Commission (Contract AT(11-1)-195).)

MICHAELIS, ARND. *See* RIEGER, RIGOMAR.

MICHIE, DONALD. The "Background Effect" on Phenotypic Variability. *Royal Veterinary College, University of London, London, England.*

The classical view of phenotypic variation interpreted the entire measurable variance in terms of the effects of genetic and environmental factors which vary from one member of the population to the next. Recent evidence is reviewed which suggests that different *uniform backgrounds,* whether genetic or environmental, result in different levels of phenotypic variability. Particular importance is attributed to uniform backgrounds which depart from the norm to which the given species has been adapted in its evolutionary past. Such backgrounds can be expected to act by *increasing* the phenotypic variance. Examples of such backgrounds are the presence in the genome of a mutant gene (Waddington, Nature, Lond. *150*: 563–565), the homozygous condition in a naturally outbreeding species (*see* Lerner, Genetic Homeostasis, Edinburgh, 1954), the genetic constitution of remote hybrids, and unaccustomed climatic, nutritional, or other environmental conditions. All these may be expected to weaken the "buffering" mechanisms of normal embryonic regulation, and thus make the individual members of the population more sensitive to the residual genetic and environmental factors which vary from organism to organism.

Possible implications of the background effect for evolutionary theory and selective breeding are suggested and discussed.

MICHIE, DONALD. *See* MCLAREN, ANNE.

MICKEY, GEORGE H. Polyploidy and Aneuploidy in *Drosophila melanogaster* Induced by Cold Shock Treatment. *Department of Zoology, Physiology and Entomology, Louisiana State University, Baton Rouge, La., U.S.A.*

First instar larvae of *Drosophila melanogaster* subjected to low temperature (about .0°C) for brief periods (2–4 hours) then permitted to recover for varying lengths of time (1–48 hours) exhibit both euploid and aneuploid cells in quash preparations of brain ganglia. Reduction in proportion of polyploid cells correlated with longer recovery periods indicates elimination of abnormal cells. Apparently only diploid cells persist to time of pupation. Single treatments produce tetraploid cells primarily; subsequent treatments after a recovery period result in some octoploid cells. Although strain differences in susceptibility to alteration by temperature shock obviously exist, extensive individual differences also are evident. No aberrations resulting from chromosomal breakage have been detected.

MIKAELSEN, KNUT. Comparisons between Cytological, Physiological and Genetic Effects of X- and Neutron-Irradiation in Barley. *Institute of Genetics and Plant Breeding, Vollebekk, Norway.*

A reported difference in radiobiological effects of X-rays and neutrons has been explained as the result of neutrons reacting more specifically with the cell nuclei while X-rays also exert their effects on cytoplasmatic cell constituents causing more physiological damage.

The differences between X-rays and neutrons will be discussed by comparing their effects on some cytological, physiological and genetic characteristics in barley.

Barley seeds were irradiated with X-rays and pile neutrons of different energies. The frequency of chromosome aberrations was studied and the results indicated that neutrons break chromosomes more seriously, revealing less restitution of broken ends, than X-rays. Seedling growth was measured, and the inhibition of growth seemed to be proportional to injured cell nuclei when analysed in metaphase, but not if analysed in anaphase.

Respiration was measured and the results indicated very similar effects for X-rays and neutrons. When the respiration was measured as oxygen uptake per any given number of seeds or dry weight unit, a significant reduction in respiration was found after both types of radiation. When the respiration rate was based on the amount of protein-N in the embryo, there was no difference between irradiated and non-irradiated seeds. Therefore, the respiration per unit active protoplasm was unchanged, and the respiration process itself was apparently not inhibited by the radiation.

Proteolytic activity in the endosperm and nitrogen transport from endosperm to embryo did not seem to be affected by the irradiations. Protein synthesis in the embryo, however, was inhibited in the irradiated seedlings. This reduced ability to synthesize protein was probably not due to any lack of necessary amino acids but rather to a reduction in nucleic acid content. This phenomenon may have some relation to the increase in dry matter content of the irradiated seedlings which was found. These experiments seem to indicate that there are no qualitative differences in the physiological effects of neutrons and X-rays and the quantitative differences are mainly due to differences in ion density of the two types of radiations.

Studies on mutation frequencies in barley seem to support this conclusion. No difference in the mutation spectrum from the two types of radiation was demonstrated. The difference in biological effectiveness may be explained on the basis of the different ion density of X-rays and neutrons (both thermal and fast).

MILANI, RICCARDO. The Genetics of the House-fly (*Musca domestica*): New Mutants, Linkage Groups and Abnormal Segregations. *Istituto di Zoologia dell' Università, Pavia, Italy.*

Several mutant types, not described before, have been found in *Musca domestica*. Some of these have been found in unrelated populations; the genes involved appear to be fairly common, at least in some populations. The commonest mutants have poor penetrance and variable expressivity. A recessive mutant type drastically affecting legs and wings (fused tarsal segments and incompletely stretched, bubbled wings) provides a fairly high number of reversions to normal; the expressivity of the effect on the legs fades over a number of generations, while the effect on wings remains constant. Several mosaics with normal have been found.

An example of parallel mutation in *Drosophila* is provided by the mutant *countercoiled* (*ctc*).

The "good" mutants have been tested for linkage. So far, a single linkage group has been established. The recombination data show very low frequency of cross-overs when the heterozygous parent is the male, very high (approximating independence) when the heterozygous parent is the female. The low cross-over rates from heterozygous males vary according to the strain used. The mutants linked are: *brown body* (*bwb*); *divergent wings* (*dv*); *knockdown-resistance* (*kdr*).

Fully penetrant mutants can provide very variable segregation frequencies in different experiments: crosses involving palearctic and nearctic strains have provided very abnormal segregations in some F_2 families, where abnormal sex ratios are also common.

MILLER, DWIGHT D. Karyotype Variation in Several *Drosophila affinis* Subgroup Species. *Zoology Department, University of Nebraska, Lincoln, Neb., U.S.A.*

Chromosomes were studied at diakinesis in primary spermatocytes of *Drosophila affinis, algonquin, athabasca, azteca,* and *tolteca*. Some differences were observed with respect to published illustrations of chromosomes of these species (Sturtevant and Dobzhansky, 1936; Patterson and Stone, 1952). *D. athabasca* and *azteca* regularly had a rod-shaped fourth chromosome instead of the J-shaped fourth chromosome previously shown. Some intraspecific variation of karyotype was found in *D. affinis* and *D. athabasca*. A strain of *D. affinis* from New York had two pairs of microchromosomes instead of the single pair characteristic of this and the other species. These species were originally described as having a large J-shaped Y-chromosome (more than half as large as the X). Although this difference was confirmed in at least some strains of each species, the Y-chromosome was found to vary within *D. affinis* and *D. athabasca*. In *affinis*, a large Y-chromosome of the kind originally described was found in strains from Nebraska, New York, and Texas. However, a small J-shaped Y (less than half the size of the X) was observed in strains from Iowa, Kentucky, Minnesota, and Nebraska, and one Nebraska strain had no Y-chromosome. In *D. athabasca*, western strains (Alaska, British Columbia, Wisconsin, and Wyoming) were found to have a large J-shaped Y, as did certain strains from Quebec. On the other hand, relatively small V- or J-shaped Y-chromosomes were encountered in strains from Michigan, Ontario, and Quebec. Moreover, strains from Michigan and New York showed evidence of a translocation between the Y and the fourth chromosome. Males of these strains had a large V-shaped Y (similar to the X), and this was associated not only with the X-chromosome but also with a single fourth chromosome, which must, therefore, represent a second X-chromosome. (Research supported by a grant from the National Science Foundation (U.S.A.).)

MILLER, JAMES R. Some Embryological Consequences of Maternal Fasting and Their Relation to the Phenocopy Concept. *Department of Genetics, McGill University, Montreal, Canada.*

The use of maternal fasting as a teratogenic agent in the mouse, first described by Runner, has been extended.

(1) The original "fasting effect," which Runner found, included anomalies of the skull, vertebrae, and ribs in 25 to 30% of the offspring of females of the strain 129 who had received a 24-hour fast on the ninth day of their pregnancies. The present work indicates that strain differences exist with respect to the time and degree of response to this treatment. These gross differences may be indicative of more subtle differences, e.g., in the time and rate of somite differentiation and/or placental development and attachment.

(2) The frequency of the cortisone-induced cleft palate in strain C57BL/6, described by Fraser and his students, can be increased considerably by a maternal fast of 24 hours, 48 hours prior to the first cortisone injection.

(3) The frequency of the sporadically occurring eye anomalies which occur in strain C57 is significantly increased in the offspring of females of the BL/6 subline who receive a 24-hour fast on the ninth day of pregnancy.

These findings will be discussed in relation to the two major genetic mechanisms which Goldschmidt postulates underlie the production of phenocopies.

MILLER, R. A. *See* WALKER, G. W. R.

MILLER, WILMER J. Subtypes in Cattle Blood Typing. *School of Veterinary Medicine, University of California, Davis, Calif., U.S.A.*

In genetic systems of blood groups involving multiple alleles, it is a general rule that many of the diagnostic reagents (antibodies) used in the differentiation of the agglutinogens or phenogroups (products of the individual alleles) exhibit so-called "subtyping" relationships. The classical example involves the subtypes A_1 and A_2 of blood factor A of man, the first of which is characterized by reaction with both anti-A and anti-A_1 reagents, whereas the second reacts only with anti-A. Many subtyping relationships of the same asymmetrical order as A_1 and A_2 have been noted with reagents reacting in the A-H, B, C, F-V, M and S-U systems of cattle. Far less attention has been given to the non-linear partitions among subtypes. A cogent example in man is that involving the so-called anti-C agglutinins which cross react with the human agglutinogens A and B but not O. Both anti-A and anti-B exhibit linear asymmetrical relationships with respect to anti-C but not with respect to each other. It is now established that many of the reagents reacting with phenogroups within such systems as B and S-U of cattle exhibit both linear and non-linear subtyping relationships. Intergradations of subtypes with other specificities, often regarded as serologically independent even though belonging to the same system of blood groups, demonstrate the need to emphasize the phenogroups rather than the individual blood factors which characterize them. Examples of cross reactions involving both linear and non-linear relationships are presented and discussed.

MITCHELL, H. K. *See* GLASSMAN, E.

MIZUSHIMA, USABURO, and KIYOSHI KATSUO. Elimination of Self-Incompatibility in the Common Cabbage, *Brassica oleracea* L., by Means of Substitution of Nucleus. *Institute of Plant Breeding, Faculty of Agriculture, Tohoku University, Sendai, Japan.*

A self-compatible strain of artificial amphidiploid(BC, $n = 17$) obtained between two self-incompatible species, *Brassica nigra*(B, $n = 8$) and *B. oleracea*(C, $n = 9$), was backcrossed to a self-incompatible common cabbage plant, the latter being continued vegetatively and used always as the pollen parent. Among the aneuploid offsprings there were found three plants that seemed to have diploid cabbage genomes in the cytoplasm of the amphidipoid which is of *nigra* origin. They resembled closely the recurrent cabbage parent in their morphology, showing normal head formation. The microsporogenesis carried out in them was quite regular with the formation of nine bivalents at MI. They were poorly fertile, but the authors were successful in continuing them by selfing. After six years of successive selfing, however, they became highly fertile and self-compatible, presenting more than 70% self-fertility. Unlike the ordinary cabbage, they showed no noticeable weakening of vigor. They always give self-compatible offsprings in crosses with the original, self-incompatible cabbage parent so far as they are used as the female parent, but give only self-incompatible ones in the reciprocal crosses, showing a clear cytoplasmic action to nullify the effect of the incompatibility gene or genes of the male parent.

MOHLER, J. D. Material for the Study of Multifactorial Gene Action. *Department of Zoology, Oregon State College, Corvallis, Ore., U.S.A.*

The concept of multifactorial inheritance is well established in genetics. Yet a major void exists. Beyond the statistically easy, but often experimentally unrealized additive concept, few general or specific ideas about the nature of gene action in such systems are current. A program which approached this problem from a phenogenetic point of view might provide some basic clues. For this purpose work has been started on a number of "crossveinless-like" (*cvl*) strains of *Drosophila melanogaster* which were selected from a variety of wild-type sources.

The present efforts are upon the genetics of some of these lines. Progress to date shows that the inheritance is not strictly multigenic, but that in each line some major switch gene is apparently present. For each, however, penetrance varies as the residual genotype is varied. Two sublines, derived from a common ancestor, with a sexlinked *cvl* have a remarkable difference in the modifier(s) in the second chromosome. In one case this chromosome is definitely suppressing; yet the penetrance in the two stocks appears to be the same. In addition to lines with a sex-linked factor another strain has a third chromosome *cvl* gene. The relationships of these switch genes to loci such as *cv* of the X and *cv-c* of the third chromosome are being investigated. That all tested chromosomes in each line do have some effect on penetrance is suggestive of a multifactorial nature of the modifying genes.

Though the trait in these cases is not determined by individually unrecognizable multifactorial differences from wild type, the lines may still be expected to be valuable tools. Indeed, only of this kind of material could one ask, how specific are the multiple modifiers of mutants at complementary loci?

MOLL, R. H. *See* ROBINSON, H. F.

MONTALENTI G., and TADINI G. VITAGLIANO. Multiple Sexual Genotypes in a Gonochoristic Species *Asellus aquaticus. Istituto di Genetica, Università di Napoli, Naples, Italy.*

Various sibships of wild *Asellus aquaticus* show a significant variation in sex ratio. Besides a number of families in which the sex ratio among sibs is 50%, others are found in which the ratio is shifted considerably and significantly toward the male (arrhenogeny) or the female sex (thelygeny). The sex ratio of the total progeny of all pairs approaches the normal (50%). This gonochoristic species has a wide range of variation of sexual genotypes, going from equality to almost complete monogeny. The tendency to arrhenogeny or to thelygeny is hereditary. The intensity of the character can be increased by selection, but in the crosses between the extremes of the same tendency a high degree of sterility results. This sterility is entirely independent of consanguinity. On the contrary the crosses between arrhenogenic and thelygenic individuals show a high heterosis. The genetic mechanism underlying such a situation is probably a polygenic sex determination with a great deal of recombination occurring at each generation. The evolutionary meaning of this condition is discussed.

MONTALENTI, G. *See* SINISCALCO, MARCELLO, *et al.*

MOORE, C. H. *See* BELL, A. E.

MOORE, RAYMOND J., and GERALD A. MULLIGAN. A Study of Natural Hybridization between *Carduus acanthoides* and *Carduus nutans*. *Botany & Plant Pathology Laboratory, Science Service, Ottawa, Canada.*

Natural hybridization between the introduced thistles *Carduus acanthoides* L. and *C. nutans* L. was noted in Grey County, Ontario, in 1951. A survey was made in 1952 and the population of one field was studied in detail as to morphology, fertility and chromosome number. The morphological variation was evaluated by means of a hybrid index. The chromosome numbers of the species are: *C. acanthoides*, $2n = 22$; *C. nutans*, $2n = 16$. All the intervening numbers occur in the hybrids, the number being correlated with the hybrid index. Among seedlings raised from seed of hybrid plants it was found that those with the chromosome number 22 were more frequent than those with other numbers. It was suggested that gametic selection may be acting to favour production of hybrids approaching more closely to *C. acanthoides* than to *C. nutans*. Grey Co. was revisited in 1957 and the present distribution of species and hybrids was recorded. Hybrid populations of 26 fields were evaluated in terms of the hybrid index scale. Hybrids were common in an area of 320 square miles in southern Grey Co., an area that seems to have been first colonized by *C. nutans*. Hybridization occurs usually on a field basis: individual fields are sites of primary hybridization, both parents and hybrids being present, or fields may contain only one parent and hybrids. In an area of approximately 18 square miles around the town of Flesherton, the parents are now rare, but hybrids are extremely common. These approach so closely to *C. acanthoides* that only careful, experienced observation would detect their hybrid nature. It is believed that hybridization first occurred in this area. The rapid dominance of the *acanthoides* phenotype supports the view that selective factors favour segregation toward this species. Fertility appeared to be higher than noted on the previous survey. The Flesherton *acanthoides*-type hybrids have spread, probably in road gravel, to a point 21 miles west of Flesherton where a large stand has become established in the past 2 to 3 years.

MORGAN, WALTER C., and RAYMOND GREB. Evolutionary Import of a Newly Discovered Mutation Affecting the Genital System in Poultry. *South Dakota State College, Brookings, S.D., U.S.A.*

Schematic patterns which outline the biological evolution of species have been theorized and expanded upon, primarily since Darwin's publication of *The Origin of Species*. Studies of fossil remains have supported evolutionary hypotheses concerning gross structural alterations. The detailed comparison of body systems and accompanying homologies, as based largely upon embryologic similarities and differences, has given rise to the phylogenetic sequence within the animal kingdom which is used as a basis for most comparative anatomy courses. However, there is a paucity of direct evidence concerning visceral changes which alter internal body systems. The purpose of this report is to consider the evolutionary potential of a mutation which grossly alters one of these body systems: the reproductive system in hens.

In many of the vertebrate species the reproductive tract consists of bilateral gonads and bilateral ducts servicing these gonads. However, in the domestic hen *Gallus gallus* there are reproductive organs (ovary and oviduct) only on the left side. Both sexes have bilateral structures during early embryological development, but there is, normally, a persistency of only the structures on the left side in females.

A specific line of Rhode Island Reds at the South Dakota Experiment Station has had a very high incidence of bilateral oviducts, >75%. This inherited condition could, conceivably, be regarded as a beneficial mutation because it provides the females with twice the normal egg-forming potential following expulsion of ova from the ovary. No effect has been observed in the male. It is possible that the mutation may be located on the disputable female sex chromosome, inasmuch as in birds the female is the heterogametic sex.

Two other points of importance are: (1) no right ovary has been observed (which is not too surprising owing to their separate embryonic origins), and (2) the presence of two oviducts would suggest a reverse-mutation, a return to the primitive state. New evidence to be included in this report will include additional autopsy data, findings from histologic sections, and pedigree charts showing the relationship of mutant females.

MORIWAKI, DAIGORO, and Y. NAKAJIMA. Maternal Effects on Heterosis owing to an Inversion in *Drosophila ananassa*. *Department of Biology, Tokyo Metropolitan University, Tokyo, Japan.*

In *Drosophila ananassa* an inversion, In II L, in the left arm of the second chromosome has long been known, two different types of gene arrangements, A and B, being distinguished. Experiments with these types, made in population cages in our laboratory, showed that a balanced polymorphism has been established by heterosis. In order to analyse the adaptive advantage of the AB heterozygotes, comparisons were made among the four karyotypes, AA, BB, AB, and BA, with respect to the physiological traits of the bearers. The results showed that marked heterosis could be expressed in the heterozygotes in the rate of development of larvae and pupae at both 25°C and 19°C, and in viability under unfavorable conditions at 25°C.

On the other hand, maternal effects on the heterozygotes, AB and BA, in the rate of development were remarkable at 25°C. These effects, seen in the F_1 heterozygotes, seem to be inherited in the next generation.

Whether the effects would be inherited through subsequent generations is still unknown, and further experiments are going on.

MORLEY, F. H. W. Sub-speciation in *Trifolium subterraneum* L. *C.S.I.R.O. Division of Plant Industry, Canberra, Australia.*

Trifolium subterraneum L. is an annual, self-fertilizing legume, derived from the Mediterranean region, now widespread in parts of Australia. The discovery of sterility in some F_1s led to an investigation of the genetic structure of this species.

Twenty "Australian" strains could be divided, on the basis of fertility of F_1s and later generations, into one set of sixteen strains (Group A), the two others, B and C, each containing only two strains.

Fertile F_1s were obtained in crosses of the Australian Group A with 6 of 11 strains from the Iberian peninsula, 4 of 10 strains from Morocco, 2 of 6 from Algeria, 2 of 2 from Turkey, and 1 of 4 from Greece. Other crosses with A strains produced infertile or non-viable F_1s, as did crosses of A strains with single strains from each of Israel, Cyprus and the Canary Islands. Of 21 F_1s from crosses among strains incompatible with Group A, the majority from different regions, all were highly sterile or non-viable. Thus there appear to be *numerous sub-species in the original habitat.* The Australian sample differs from the Mediterranean sample in containing such a high proportion of strains in Group A, and representatives of only three affinity groups. This suggests that these *introductions to Australia came from a restricted portion of the original habitat.*

There are no indications that affinity groups other than A are widespread, as would be expected if the distribution of A were determined by migration. The pattern of distribution observed suggests that *subspecific differentiation occurred on many independent occasions, and in a variety of locations, rather than at a centre of variation.*

MORPURGO, GIORGIO, and GIUSEPPE SERMONTI. Genetic Instability in Diploid Strains of *Penicillium chrysogenum*. *Istituto Superiore di Sanita, Rome, Italy.*

A conidial suspension of the green diploid strain of *Penicillium chrysogenum* $\frac{+\ +\ w\ cy}{y\ py\ +\ +}$ was treated with nitrogen mustard to give about 0.5% survival. Treated conidia were plated on complete medium: colonies arising from these conidia show a very increased percentage of white and yellow, as sectors or whole colonies (30 to 40 per cent) if compared with segregation of the control (1%–). One-third of the green conidia from the colonies showing yellow or white sectors, plated without further treatment on complete medium, show a very high rate of sectoring (almost 100%). From the few colonies which do not give sectors, stable subclones in which the markers showing a high segregation rate were still present in heterozygous condition were readily obtained. The tendency to give sectors may be maintained for an indefinite number of generations by plating green conidia. Nine unstable clones from different colonies have been isolated so far. One other unstable clone was derived from a mosaic colony which had formed spontaneously. Each clone always gives sectors of the same type: 4 clones give yellow prototroph sectors; 1 yellow cysteine; 1 white prototroph; 1 white cysteine; and 2 give two types of sectors, namely white cysteine and yellow pyridoxine. In four strains in which we have investigated, after treatment with N-mustard or U.V., we were able to find markers which do not normally appear in the sectors.

Sectoring is completely abolished if conidia of unstable lines are plated on complete medium + 0.8% of $MnCl_2$. Nevertheless conidia of such colonies grown on C.M. + $MnCl_2$, plated on C.M. without $MnCl_2$, again give sectors. Salts of Ca^{++}, Co^{++}, Cu^{++}, Fe^{++}, Mg^{++}, Ni^{++}, do not produce this effect. $MnCl_2$ also diminishes the percentage of segregants appearing as sectors or whole colonies after treatment with N-mustard.

The authors discuss the possible explanations of such genetic instability.

MORPURGO, GIORGIO. *See* SERMONTI, GIUSEPPE.

MORRIS, ROSALIND. *See* LIMA-DE-FARIA, A.

MORRISON, JOHN H. The Effect of Monoiodoacetic Acid on Cell Division. *Michigan State University, East Lansing, Mich., U.S.A.*

Treatment of root tips of *Pisum* with monoiodoacetic acid inhibits the chromosome movement cycle during all stages of the mitotic process in meristem cells without apparent alteration of the morphological cycle of the chromosomes. Iodoacetic acid prevents kinetochore cleavage with the result that chromosomes in metaphase configurations undergo telomorphic transformation *in situ*. The study and measurement of the cytological effects of iodoacetic acid show that the time required to obtain complete inhibition of chromosome movement of a given mitotic stage is dependent on the molar concentration of iodoacetic used. The fact that iodoacetic acid is known to inhibit the triosephosphate dehydrogenase system which is one of several pacemaker reactions in anaerobic glycolysis, the results of the iodoacetic acid reaction suggest that there exists a relationship between the energy-yielding reactions of glycolysis and the chromosome movement cycle during the mitotic process.

MORTON, N. E., and C. S. CHUNG. Formal Genetics of Muscular Dystrophy. *Department of Medical Genetics, University of Wisconsin, Madison, Wis., U.S.A.*

Genetic classes of muscular dystrophy delimited by pedigree information and discriminant functions (Chung and Morton, X Genetics Congress) were analysed by maximum likelihood scores. Group I is generally attributable to an autosomal dominant gene of complete penetrance in individuals who survive to the age of onset. The clinical type is facio-scapulo-humeral. Isolated cases of group II are mostly true sporadics, of undetermined etiology, while familial cases are consistent with an autosomal recessive gene or genes with complete penetrance above the age of onset. The segregation analysis confirms the phenotypic evidence that about 40% of group II cases are sporadic, this proportion being homogeneous among sources of data. In both isolated and familial cases, the clinical type is usually limb girdle, sometimes Duchenne. Group III cases are sex-linked and Duchenne in type, with complete penetrance. Cases of group IV, classified by a discriminant function into probably of genetic type II or probably of genetic type III, are found to have the distribution expected on this hypothesis.

When the sex-linked cases are analysed with respect to the proportions of sporadics and of affected uncles, excellent agreement is obtained with frequencies predicted on the assumption of equal mutation rates in egg and sperm. The assertion of Haldane, that there is deficiency of sporadic cases and therefore evidence for higher mutation rates in males than in females, is based upon an inappropriate formula, and there is no evidence for his claim even in the data which he examined.

The proportions of sporadics and of affected uncles are homogeneous among sources. Estimates of incidences, gene frequencies, fertilities, mutation rates, and genetic risks by several independent methods will be given.

MORTON, N. E. *See* CHUNG, C. S.

MOSSIGE, JEANNE. Translocations and Recessive Sex-Linked Lethals Induced in *D. melanogaster* by Ingested Radiophosphorus. *Norsk Hydro's Institute for Cancer Research, Norway.*

The findings of Oftedal and Mossige that incorporation of P^{32} in sperm followed the same curve as the mutation rate for sex-linked recessive lethals in daily broods suggested the possibility that some of the mutations might be due to the disintegration of P^{32} incorporated in the genetic material. In an attempt to elucidate this question the day-to-day mutation curve for II–III translocations was determined.

After an acute dose of radiation to newly eclosed males, the daily sensitivity pattern for translocations and recessive lethals has been determined. If, after ingestion of P^{32}, an appreciable number of mutations is due to disintegrations in the genetic material, and if these disintegrations are able to produce breaks leading to translocations as well as to sex-linked lethals, translocations should be found among the progeny of days 9 and later as these could be induced by disintegration in postmeiotic sperm. No such translocations have been found.

MOTA, MIGUEL. Karyokinesis without Cytokinesis in the Grasshopper. *Biology Division, Oak Ridge National Laboratory, Oak Ridge, Tenn., U.S.A.*, and *Estação Agronómica Nacional, Sacavem, Portugal.*

Preparations of living grasshopper spermatocytes of the species *Melanoplus differentialis* and *Chortophaga viridifasciata* (De Geer) were made to provide material for an experimental study of the anaphase movement. In these preparations many cells were found where cytokinesis had not followed karyokinesis, resulting in binucleate cells from both primary and secondary spermatocytes. In some of these cells a clearly visible ring of jelly-like substance, brighter under phase microscope than the surrounding cytoplasm, could be seen constricting the middle of the bunch of mitochondria that outlines the spindle remnants, very much in the same way the cleavage furrow does in a normal cytokinesis. The ring did not last more than fifteen minutes under observation, breaking and fading away after that period of time or earlier. The origin of this aberration is unknown.

The finding of such a ring gives support to the theories that explain cell cleavage assuming the existence of a contracting ring located on or immediately under the cell membrane at the equator. It seems clear that in these cases the ring contracted but separated from the cell membrane.

Motulsky, Arno G. Joseph Adams (1756–1818): The Forgotten Founder of Medical Genetics. *Department of Medicine, University of Washington, Seattle, Wash., U.S.A.*, and *Galton Laboratory, University College, London, England.*

A British physician-apothecary, Joseph Adams, published a book in 1814 entitled *A Treatise on the Supposed Hereditary Properties of Diseases Based on Clinical Observation.* The identical book was reissued in 1815 under the title *A Philosophical Treatise on the Hereditary Peculiarities of the Human Race.* The author showed remarkable insight into some principles of human genetics still applicable today. As far as can be ascertained, little attention was given to his findings.

The stated aim for the book was to furnish a guide for heredity counselling. Adams made the following observations. (1) Clear distinction between congenital, familial ("recessive") and hereditary ("dominant") conditions and their patterns of inheritance; (2) some of the characteristics of familial (recessive) diseases were noted, i.e., mating between relatives would increase the disease frequency. (3) Hereditary diseases may manifest at various age periods and not necessarily at birth. (4) Hereditary susceptibilities exist which need external precipitating factors to make illness apparent. In terms of risk for offspring, it is immaterial whether clinical disease is present or not. (5) Genetic illness may be treatable especially if precipitating factors may be removed. (6) Intrafamilial correlation of age of onset of hereditary diseases exists and is clinically useful in genetic prognosis. (7) He hinted at genetic heterogeneity of clinically identical disease. (8) Increased hereditary disease frequency in isolated districts may be caused by inbreeding. (9) He logically predicted mutations by stating that genetic disease would disappear due to early death of the affected were it not for new origin of the condition in offspring of parents free from it. Adams' attitude to practical eugenic measures was critical and again quite modern. He concluded by calling for the establishment of hereditary disease registers for further study.

Joseph Adams' biography and the failure of medical scientists to note his observations will be discussed against the background of early nineteenth century science and medicine.

Moutschen, Jean. Action combinée du Myleran et des rayons X sur les graines de *Vicia faba* L. *Institut de Morphologie Végétale, Laboratoire de Cytogénétique, Université de Liège, Liège, Belgique.*

Le Myleran, 1–4 bis-(méthyl-sulfonyloxy) butane, utilisé sur des graines de *Vicia faba* avant et après irradiation par les rayons X, modifie considérablement les effets de ceux-ci sur les chromosomes. Un temps d'action de 20 minutes (20 mg./ 100 cc.) est suffisant pour inhiber en grande partie la genèse des ponts chromosomiques apparaissant normalement après irradiation. D'autre part, les cassures chromosomiques dues au Myleran et aux irradiations agissant simultanément s'additionnent. Le traitement par le Myleran après irradiation produit encore des modifications dans les effets des rayons variant avec le moment auquel la substance est donnée. Le Myleran donné 16 heures après l'irradiation relève fortement le taux de ponts chromosomiques mais celui-ci n'atteint cependant jamais le taux que l'on observe après les rayons X seuls.

Les modifications de la répartition des cassures chromosomiques dues à l'action conjuguée des deux agents ont été étudiées et l'intérêt pour la cytogénétique de l'action de ces agents en combinaison a été souligné.

MOUTSCHEN, JEAN. *See* MOUTSCHEN-DAHMEN, MADELEINE.

MOUTSCHEN-DAHMEN, MADELEINE, et JEAN MOUTSCHEN. Le maintien en première génération des lésions chromosomiques dues à la 8-éthoxycaféine chez *Vicia faba* L. *Institut de Morphologie Végétale, Laboratoire de Cytogénétique, Université de Liège, Liège, Belgique.*

Les lésions classiques dues à la 8-éthoxycaféine ont été suivies dans 30 plantes de *Vicia faba* L. provenant de graines traitées. De ces 30 individus, 90 ont été obtenus en première génération. De nombreuses lésions chromosomiques ont été retrouvées dans les méristèmes radiculaires de ceux-ci et leur évolution a été également suivie. La répartition dans le génome de ces lésions chromosomiques relevées en première génération a été comparée à la répartition des lésions observées chez les parents; la spécificité de localisation des cassures dues au toxique se maintient.

Il est étonnant qu'au grand nombre d'aberrations chromosomiques spécifiques relevées ne corresponde qu'un nombre restreint d'anomalies morphologiques.

MUKAI, TERUMI, and ALLAN B. BURDICK. Single Gene Heterosis Associated with a Second Chromosome Recessive Lethal in *Drosophila melanogaster*. *Department of Biological Sciences, Purdue University, Lafayette, Indiana, U.S.A.*

A clear demonstration of single gene heterosis for viability associated with a second chromosome recessive lethal is described in this report.

In a case of superviability of heterozygotes, the proof of single gene heterosis must rest on the elimination of the contribution of (*a*) the genetic background, and (*b*) specific interaction between the genetic background and the gene in question towards the observed superviability. The former can be achieved by tracing the frequency of lethal heterozygotes under random mating generation after generation because the genetic background becomes equalized for the two kinds of flies ($l/+$ and $+/+$) by crossing over and random mating if the lethal is not contained within an inverted segment. The latter can be achieved by testing the degree of heterosis in different genetic backgrounds.

The lethal gene is located at about 54 on the second chromosome and is not associated with crossing-over inhibition. Four populations were established, the frequencies of lethal heterozygotes in the starting generation being 1 in Populations 1 and 2, and 0.05 in Populations 3 and 4. The genetic backgrounds of Population 1 and 3 were the same and those of Populations 2 and 4 were the same. The populations were established and tested at different times but were propagated under the same schedule and density. The four populations reached the same equilibrium point where the frequency of lethal heterozygotes is about 0.42, and this has been maintained for about 300 generations.

The experimental results indicate superviability of lethal heterozygotes and from other experimental results, the cause of superviability is attributable to higher fecundity of lethal heterozygote females and/or better mating ability of lethal heterozygote males.

In conclusion, it can be said that the superviability of these lethal heterozygotes is due to single gene heterosis.

MUKAI, TERUMI. *See* BURDICK, ALLAN B.

MUKHERJEE, BARID B. *See* VICKERY, ROBERT K.

MULLIGAN, GERALD A. *See* MOORE, RAYMOND J.

MUNDAY, ANN. *See* FRANKEL, O. H.

MUNKRES, K. D., V. W. WOODWARD, and V. SUYAMA. Metabolic Analyses of Certain Pyrimidine-Requiring Mutants of *Neurospora*. *Kansas State College, Manhattan, Kan., U.S.A.*

The evidence that pyrimidines are metabolized by dual pathways in *Neurospora,* as in bacteria and mammals, is threefold: (1) growth studies, (2) accumulation products, and (3) enzyme activity. The significance of the dual pathways in terms of genetic-metabolic relations will be discussed. That a reductive pathway for uracil metabolism exists in *Neurospora* was first suggested by positive growth responses of the pyrimidine-requiring mutant, pyr-1 (263), to dihydrouracil (DHU) and B-ureidopropionic acid (B-UP). We now have other mutants, 1g, pyr-5, and KS-12, that respond only to DHU. Still another class of mutants (pyr-3 and its pseuodoalleles) respond only to uracil. No pyrimidine mutant responds to B-alanine. Analyses of culture filtrates of 73a, pyr-1, pyr-3, pyr-5, KS-12 and 1g, when grown on uracil, reveal DHU and B-UP, whereas minimal cultural filtrates of 73a do not. Pyr-5 and KS-12 are unique in that B-UP accumulates in much higher concentrations. Finally, enzyme activity for the hydrolysis of DHU to B-UP in pyr-1, pyr-3, and 73a has been detected. Tuttle and Mitchell (personal communication) have observed enzymic conversions of ureidosuccinic acid (US) through to uridine in the orotic acid pathway, as well as the accumulation of dihydroorotic acid (DHO) and US in pyr-1. We have corroborated the latter and, in addition, have found that pyr-5 and KS-12 accumulate US and either DHO or 5-carboxymethylhydantoin or both. (This research was supported by a research grant from the National Institutes of Health, RG-4561 (C2). Contract No. 617, Kansas Agricultural Experiment Station.)

MUNKRES, K. *See* WOODWARD, VAL W.

MURAKAMI, UJIHIRO. On the Pathogenesis of Congenital Malformations of the Central Nervous System: A Study of Phenocopies of the Mouse. *Research Institute of Environmental Medicine, Nagoya University, Chikusa-Ku, Japan.*

Mice were injected with 0.1 cc. of 1% trypan blue between the sixth and ninth day of pregnancy and the uterine contents were examined on the thirteenth day. In the group treated on the eighth day, pseudencephalies were seen more frequently than in groups treated on other days. Mothers exposed to hypoxia on the eighth day of pregnancy produced many embryos with curvatures of the spinal cord, plications of the brain, and hydrocephalus. In both experiments, other kinds of abnormalities corresponding to distended central nervous system as described by Snell *et al.* were seen—especially in embryos dying during the tenth to twelfth day of embryonic life. These distensions of the central nervous system were often associated with enlargement of the pericardium.

When such distensions of the central nervous system were examined microscopically, proliferation of ependymal elements with abundant mitoses often accompanied by excess cerebrospinal fluid was found to underlie overgrowth and distortions of the central nervous system. Numerous transitional forms of central nervous system malformation were observed, varying from uncomplicated distension of the central nervous system to pseudencephaly, brain hernia, brain plication, spina bifida, or combinations of these defects.

In young embryos in which the choroid plexus is not yet formed, cerebrospinal fluid is produced by ependymal cells and presumably when ependymal cells proliferate excessively their function of producing cerebrospinal fluid is also accelerated. Sometimes small elevations of ependymal elements were seen in the brain of an embryo with hydrocephalus. I suggest that hydrocephalus, pseudencephaly, brain hernia, and spina bifida, originating in embryonic life, have their basis in the proliferation of ependymal elements which represents a non-specific reaction to diverse agents including X-radiation, P^{32}, and HVJ-virus infection.

MURAMATSU, M. *See* MATSUMURA, S.

MURRAY, MERRITT J. Evolution in the Genus *Mentha*. *A. M. Todd Company, Kalamazoo, Mich., U.S.A.*

Taxonomists have long believed that the genus *Mentha* consists of five fertile pure species and numerous sterile F_1 hybrid combinations between these species. For example, fertile wild spearmint *Mentha spicata* L. ($2n = 48$) is considered an F_1 hybrid between *Mentha rotundifolia* L. ($2n = 24$) and *M. longifolia* (L.) Huds. ($2n = 24$). The pioneer cytogenetic work of Mabel L. Ruttle (Mrs. B. R. Nebel), 1929–38, has shown that the basic fertile species hybridize freely to form fertile *M. Niliaca* Jacq. em. Briq. with 24 chromosomes. We have confirmed her observations and found that the F_1 hybrids are Niliaca-like in appearance, but differ from sterile *M. Niliaca* ($2n = 36$) in oil composition. Neither the diploid nor the double-diploid hybrids resemble *M. spicata* in appearance. In oil chemistry, the basic species and their F_1 hybrids have the ketones piperitone oxide and piperitenone oxide whereas the very polymorphic species *M. spicata* may have these same ketones or carvone and dihydrocarvone or menthone and pulegone. While the evolution of the ketone differences is due to the mutation and interaction of two dominant genes, the exact parentage of *M. spicata* is uncertain. On the other hand, sterile peppermint *M. piperita* L. ($2n = 72$) is synthesized by hybridizing water mint *M. aquatica* L. ($2n = 96$) to menthone and pulegone strains of *M. spicata* ($2n = 48$). Herbarium material will be used to illustrate the species and hybrids.

MURTY, B. RADHAKRISHNA, and N. R. BHAT. Male Sterility in *Nicotiana tabacum*. *Central Tobacco Research Institute, Government of India, Ministry of Food and Agriculture, Rajahmundry, India.*

The nature of action of the duplicate factors controlling male sterility in a spontaneous mutant of *Nicotiana tabacum* is described. Male sterility was recessive to normal cytological studies of the breakdown of microsporogenesis in the mutant, and the sterile segregants from crosses with other unrelated types showed that in addition to the deformation of the anthers, the breakdown at several stages started from the differentiation of tapetum while megasporogenesis was inferentially normal.

Studies of F_3 progenies from partial sterile and normal segregants of F_2's revealed that one of the duplicate genes is responsible for the restriction of the sporogenous tissue by deforming the anther. The other gene operated only in succession to the first and controlled the tapetal differentiation and other meiotic irregularities following the abnormal development of tapetum. The partially sterile segregants were never true breeding and segregated into 1 normal: 2 partial: 1 completely sterile, indicating that they are heterozygous for one gene and homozygous recessive for the other.

The regular association of the characteristic reduction in size and width of corolla tube with male sterility in all families indicated the pleiotropic effect of the mutant genes.

It is inferred that the absence so far of reports of male sterility in the putative species of *tabacum* is probably due to the elimination of deleterious genes in the diploid species as suggested by Clausen and Cameron (1952) or due to the complementary duplicate action of the male sterility genes in successive stages.

NAKAJIMA, Y. *See* MORIWAKI, DAIGORO.

NAKAO, YOSHIO. Further Study on Specificity of Interactions between the Individual Gene Locus and the Structure of Chemical Mutagens. *Biological Institute, Kyoto Prefectural Medical College, Kyoto, Japan.*

Using the egg colour mutants of the silkworm we have discovered a specific relationship between individual gene locus and two related agents of the mustard groups, nitromine and N.M.-alanine, (Nakao, Tazima and Sakurai, Z.i.A.V., in press). Further, relative frequencies of the same mutants induced by N.M.-glycine (N-bis-β-chloroethyl-glycine) and N.M.-alanine-amide (N-bis-β-chloroethyl-alanine-amide) have been tested. In the silkworm, *pe* and *re* are located on chromosome V at 0.0 and 31.7, and both of them control the colour of the egg (and also colour of the eye). Whereas the normal colour is black, *pe/pe* eggs are white and *re/re* eggs red. Eggs homozygous for both *pe* and *re* are also white. We injected 0.05 ml. of either solution of N.M.-glycine (1/30%) or N.M.-alanine-amide (1/50 %) into the abdomen of the wild male moths which were then mated to double recessive *pere/pere* female moths. Eggs produced from these matings were examined for their colour and the mutation rates were estimated by the ratio of uncoverings at the marked loci to the total pigmented eggs.

Analysis of the results has revealed that the ratio of the mutation rates at *pe*-locus to those at the *re*-locus varies considerably according to the mutagens injected. When N.M.-glycine was used, the ratios were 1.06 and 1.31; when N.M.-alanine-amide was injected, the ratio was 0.07.

NATARAJAN, A. T. *See* SWAMINATHAN, M. S.

NAVASHIN, MICHAEL S. Cell Size and Development of Characters. *Botanical Institute of the Academy of Sciences of the USSR, Leningrad, U.S.S.R.*

It is a well-known fact that tetraploid individuals do not represent enlarged copies of their diploid progenitors although they differ from the latter merely in possessing reduplicated genomes, i.e., in a purely quantitative way.

As shown by numerous investigations the primary effect of tetraploidy consists in doubling the volume of the protoplast of the meristematic cell. In the course of ontogenesis, however, additional features become manifest, both in specialized cells and in organs. It was thus found that, although all the cells of the tetraploid plant are on the whole larger than those of the diploid, the increase is different in different tissues, and what is still more striking, the organs of the tetraploid acquire morphological peculiarities of their own. Among these the most important characteristic is an altered width/length ratio which is markedly increased in tetraploids.

The author has focused his attention upon the fact that the volume of organs (especially of those which possess determinate growth, e.g., seeds) is in tetraploids less than twice that found in diploids, as could be expected from the doubled cell size. Measurements have shown that the volume of organs in tetraploids is 1.6 times greater than in diploids, this ratio recurring with remarkable constancy. Starting with the observation that the value 1.6 practically coincides with the ratio $\frac{2}{\sqrt[3]{2}}$, the author advanced a hypothesis according to which the morphological peculiarities of the tetraploids depend basically on a decrease in relative surface of their meristematic cells which is obviously proportional to $\frac{1}{\sqrt[3]{2}}$ and represents an unavoidable result of an increase in absolute dimensions. If we assume that the decrease in the rate of cell division known to be connected with tetraploidy is proportional to the decrease in relative cell surface, the peculiarities of tetraploid individuals will receive a natural explanation. Namely, an increase 1.6 times (instead of 2.0 times) will be understood as a consequence of doubling cell volume combined with a corresponding decrease in their number $\sqrt[3]{2}$ times; which thus should result in an $\frac{2}{\sqrt[3]{2}} = 1.61$ ultimate increment. An increase in the relative width of elongated organs would also appear to be a simple geometrical consequence of reduced number of cells along the axis of predominating propagation of cells, the latter at the same time possessing greater dimensions.

The author's hypothesis was verified on pappus bristles of diploid, triploid and tetraploid individuals of Russian dandelion (*Taraxacum kok-saghyz* Rodin). The number of cells composing these structures proved to be inversely proportional to cubic radicals of the corresponding cell volumes (i.e., 2, 3 and 4). Several suggestions are made by the writer as regards physiological importance of variation in cell size. Cell size is considered by him to be a primary factor of initial differentiation; quantitative variation in cellular elements may thus result in qualitative characteristics of the organism.

NAYLOR, J. K. *See* STICK, H. F.

NELSON, OLIVER E., Jr. Intercrosses among Alleles at the Waxy Locus in Maize. *Botany and Plant Pathology Department, Purdue University, Lafayette, Indiana, U.S.A.*

The *Wx/wx* locus in maize governs the type of starch produced in both the microspore and the endosperm. *Wx* starch is a mixture of amylose and amylopectin and stains blue-black with a dilute solution of KI and I_2, while *wx* starch lacks amylose and stains reddish-brown with the iodine solution. The starch type of a microspore is conditioned by its own genetic constitution and not by that of the plant producing it. This makes it possible to use the large number of microspores produced by a single plant as a population for genetic investigation, thus obtaining a resolution far higher than is usually possible with higher organisms.

All possible intercrosses have been made between six independently occurring mutations at the *Wx/wx* locus. Pollen samples were collected shortly before pollen shedding from the parental *waxy* stocks and the intercrosses. Pollen smears are prepared by breaking up a definite number of anthers (42) in a standardized iodine solution with a Virtis homogenizer. The pollen suspension is strained onto a large slide and covered with a 50 × 75 MM cover slip. Such a preparation usually contains about 50,000 pollen grains.

The smears are scored for the number of black-staining pollen grains (presumably *Wx*) present. These contrast markedly with the reddish brown color typical of *wx* grains. In the parental stocks the incidence of black grains is always low ($.42 \times 10^{-5}$ to 1.37×10^{-5} being the range). The analysis of the intercrosses is not yet complete, but apparently the incidence of black-staining grains depends upon the cross. Some crosses show no increased number of black grains over the parent stocks while others show a significant increase. The increased numbers of dark-staining grains in some crosses suggest the complexity of the *Wx/wx* locus.

NEUFACH, A. A. *See* PROKOFIEVA-BELGOVSKAYA, ALEXANDRA.

NEWCOMBE, H. B., A. P. JAMES, and S. J. AXFORD. Genetic Hazards and Vital Statistics. *Atomic Energy of Canada Limited, Chalk River, Ont., Canada.*

The genetic damage to a human population resulting from a given exposure to radiation could be estimated with much greater confidence if we knew what part of our present hereditary ills and handicaps are due to recurrent natural mutations, and what part to differentials of fertility in the form of higher reproductive rates in the seemingly unaffected carriers of the genes. A method has been proposed by the Biology Branch of Atomic Energy of Canada, Limited, for surveying large human populations in order to distinguish between the respective roles of selection and mutation in maintaining the present load of hereditary defects.

The method uses the very large volume of routinely collected records of marriage, birth, ill-health, and death, to derive individual family fertilities and correlate these with the occurrence of various diseases. Mechanical or electronic handling procedures and a system of "family name codes" (or "genetic name codes") are used to bring these records (e.g., in punch card or magnetic tape form) into family groups.

A plan for a test study in the Canadian Province of British Columbia (present population about 1,400,000), based on marriage records over a ten-year period (1946–55), illustrates the technical and practical aspects of the undertaking. The children from these marriages would number about 150,000 by the end of 1958. Of these 10,000 would be stillborn, die in infancy, or appear in the register of crippled and handicapped children by the end of 1959; and a further 10,000 would be born with abnormally low birth weights, a characteristic known to be correlated with early death. About 30 to 40% of the stillbirths, infant deaths, and early defects, considered collectively, are believed to be hereditary; likewise, causes of birth weight variations are believed to be about 40% genetic. Thus, appropriate population studies would permit very substantial numbers of families to be used in the detection of fertility differentials.

NICOLETTI, BENEDETTO, and ANGELA SOLIMA. The Role of Selective Mating in Artificial Populations of *Drosophila melanogaster. Istituto di Genetica dell'Università di Napoli, Naples, Italy.*

The results of many experiments (made with the help of G. Morpurgo) led us to the belief that selective mating cannot be considered as the only and main factor for the gene-frequencies evolution in artificial populations of *Drosophila melanogaster.* C. Petit (1954) came to the same conclusion, emphasizing that during the competition among Bar and normal individuals, the elimination of mutants was due not only to a coefficient of sexual selection but also to a high coefficient of larval selection. The results of recent experiments performed with isogenic strains (normal and Bar 39th brother-sister mating) show that, besides these two coefficients of selection, other components of fitness must be considered.

Measurements of fecundity, fertility, longevity, hatchability, female and male sterility show that Bar homozygous are in respect to the normal inferior in these characters too.

As a reasonable conclusion we think that a sexual coefficient of selection alone cannot account for the evolution of laboratory populations. The components are many and certainly not negligible and these, together with the possibility of sexual selection, contribute to the determination of relative fitness of individuals of a given genotype.

Nilan, R. A. *See* Blickenstaff, Joyce; Kamra, Om P.

Noda, Shozo. *See* Haga, Tutomu.

Norman, A. *See* Siegel, Albert.

Noronha-Wagner, M. *See* Câmara, A.

Nuffer, M. G. A Crossover Analysis of Mutable Alleles at the *A* Locus in Maize. *University of Missouri, Department of Field Crops, Columbia, Missouri, U.S.A.*

In order to determine the nature of the factors involved in mutable behavior at the A_1 locus a heterozygote composed of two distinguishable mutable alleles, one *Dt*-influenced and one *Ac*-influenced, but lacking these mutator factors, was prepared. One segment (ɑ *a sh*) carried ɑ (the dilute component of the compound A^b *allele*), *a* (a *Dt*-responding component of the A_1 locus) and sh_2 (a recessive shrunken endosperm character) all within a map distance of 0.25 crossover units. The other segment ($a^m Sh$) carried either a^m-*1* (a *Dt*-responding highly mutable component of *A*), a^{m-3} (an *Ac*-responding allele), or a^{m-4} (another *Ac*-responding allele), depending on the experiment, and Sh_2. The heterozygote was crossed by the complete recessive a^s *sh*. Progeny from the a^m-*1* heterozygote included the crossover types ɑ a^m *Sh, a a Sh,* ɑ*-Sh,* a^m *sh, a sh,* and a^m *a sh* which showed that pairing was random at the *A* locus in this case. The phenotype of the a^m *a sh* crossover cases indicated that the two mutable alleles can mutate independently even when closely associated on the same chromosome segment. Progeny from the a^{m-3} and a^{m-4} heterozygotes gave similar crossover types except that the ɑ a^m *Sh* class was missing (the reciprocal *a sh* class was indistinguishable), suggesting preferential pairing. The frequency of crossing-over was strikingly different in the a^{m-3} heterozygotes. The rates expressed in crossover units were a^m-*1*, .11; a^{m-3}, .013; and a^{m-4}, .079. This may be due to the type of event involved in the origin of a^{m-3}. Preliminary investigations reveal no change in the mutability or phenotype of these alleles that can be attributed to crossing over. (Contribution from the Missouri Agricultural Experiment Station, Journal Series No. 1860. Approved by Director.)

Oakberg, Eugene F. The Effect of X-Rays on the Mouse Ovary. *Biology Division, Oak Ridge National Laboratory, Oak Ridge, Tenn., U.S.A.*

Past work has shown that female mice have an average of 4 litters after an acute exposure to 50 r, then become permanently sterile; whereas in males, fertility is regained after doses of 1,000 r or more. Adult female hybrid (101 × C3H) mice killed 3 hours to 70 days after 50 r of X-rays were used to determine the basis for the different response of the ovary.

Early oocyte stages are extremely sensitive, but as the follicle develops the contained oocyte becomes more resistant to radiation-induced necrosis. All the earliest stages had degenerated and completely disappeared in 48 hours. Extensive degeneration of oocytes also occurred in follicles with a single layer of cells, but rare survivors were observed. Oocytes in follicles with several layers of cells showed an increased degeneration after 24 hours, but the number of normal cells was still 60% of control at 20 days. No increased degeneration of oocytes was observed in follicles with an antrum, but the number of mature follicles gradually declined as a result of failure of replacement from younger stages. No new formation of oocytes was observed, supporting the theory that oogonia do not persist in the adult. Thus the extensive regeneration characteristic of the irradiated testis cannot occur. Also, the genetic effects of irradiation of adult female mice cannot involve the oogonial stage.

Since the first meiotic division is not completed until shortly before ovulation, almost all germ cells in the adult ovary are primary oocytes. These oocytes are remarkably uniform in appearance, all being in the dictyate stage. Thus, apart from irradiations made shortly before fertilization, genetic effects will involve only this stage. This should be borne in mind when comparisons are made with male mice or with females of species where a different spectrum of stages is present.

Ohkura, Koji. *See* Tanaka, Katumi.

Okamoto, M. *See* Sears, E. R.

Oksala, Tarvo A. Segregation and Missegregation of Chromosomes in the Female Meiosis of *Drosophila melanogaster. Institute of Genetics of the University of Helsinki, Helsinki, Finland.*

The author's investigations on the mechanism of non-disjunction have shown that it is highly probable that proximal heterochromatic blocks have a tendency to pair indiscriminately in the meiosis of the female *Drosophila melanogaster*. As a consequence, the centromere regions of even heterologous chromosomes often come into contact with each other. Sometimes this results in a missegregation (non-disjunction) of the chromosomes, which in turn leads to the formation of non-viable zygotes. The frequency of eggs of this type is different in inversion heterozygotes from that in structural homozygotes. The differences are explicable on the assumption that a bouquet orientation prevails in the early meiotic stages.

Olah, L. v. Cytological Investigations in *Corypha* Palms. *Biology Department, Duquesne University, Pittsburgh, Penn., U.S.A.*

The meiotic division of two monocarpic palms, *Corypha umbraculifera* L. and *C. elata* Roxb., was investigated in the Botanic Garden of Bogor (Buitenzorg), Java. Two phenomena were observed in both species investigated: (1) the formation of nucleolar buds on the nucleolar organizing region, during prophase of the first division of PMCs; (2) the appearance at zygotene of a Feulgen-positive substance, on the same region, or on the upper segment of the SAT-chromosomal threads attached directly to the nucleolar bulk.

A statistical approach was made to follow the formation and the disappearance of the nucleolar buds. Based on the observation of 9312 PMCs of *C. elata*, it was found that the budding process starts at leptotene and culminates at pachytene. The majority of the buds disappear in *C. umbraculifera* before diakinesis whereas in *C. elata* they disappear somewhat later.

The attachment of the SAT-chromosomes is collar-like on budded nucleoli, being located at the narrowest part of the budding nucleolus, i.e., between the nucleolus and the bud. In *C. umbraculifera* a darkly stained Feulgen-positive substance appears at this region, and becomes very conspicuous at early zygotene. Later on it seems to leave this place, often taking the shape of dot-drop or of rod-like bodies. These semi-liquid bodies seem to flow along the threads and subsequently are found among them. But in *C. elata* this substance appears at the upper segment of the SAT-threads, attached directly to the nucleolar bulk, and its quantity is noticeably less; consequently the above-mentioned motion is hardly observable. In both species this Feulgen-positive substance disappears at the end of zygotene.

The metaphase and the subsequent phases are as usual. The haploid chromosome number of both species is 18. Since no secondary pairing was observed in either species they are not considered to be polyploid. This observation supports the view of Sato who suggests that the basic number in "Corypheae" is 18.

Of several hypotheses put forward to explain the origin of nucleolar buds, the above observations lend most support to the hypothesis of Resende.

Based on the above finding in *Corypha* palms regarding the formation of Feulgen-positive bodies, a new light is thrown on the question of the origin of the heterochromatic bodies.

Olive, Lindsay S., and A. J. H. Carr. Crossing Self-Sterile Mutants of *Sordaria fimicola. Department of Botany, Columbia University, New York, N.Y., U.S.A.*

Spontaneous and irradiation-induced mutants have been obtained which range from reduced fertility to complete sterility. Blockage of fertility may occur at the following stages: (1) ascogonial development, (2) perithecial maturation, (3) ascus maturation (with the asci or ascospores aborting), (4) ascospore germination (germ tubes aborting). With the aid of ascospore color mutants for markers, fertile crosses may readily be obtained by pairing certain self-sterile cultures with self-fertile cultures, in which case crossed perithecia are often produced in abundance, along with pure wild-type perithecia. Perithecia of the sterile genotype may or may not develop, depending upon the sterile mutant used.

Paired self-sterile mutant cultures, often of less than normal growth rate, produce fully fertile heterokaryotic mycelia that are wild-type in appearance. These mycelia, in the crosses studied so far, produce crossed perithecia and perithecia of one of the sterile parental genotypes, the number of crossed perithecia often exceeding two-thirds of the total (preferential cross-karyogamy), or else they produce only crossed perithecia. An analysis of the first type of cross has shown that sterility is controlled primarily by two non-allelic, unlinked loci, one in each parental strain. In the latter cross, one parental strain carried a single locus for sterility, while the other carries two, both of which cause ascospore germ-tube abortion. Since these crosses involve non-allelic mutant loci and yield some self-fertile recombinants, they represent an *unbalanced heterothallism*, somewhat similar to that known to occur in a number of fungi in nature.

It is suggested that *balanced heterothallism* may have arisen repeatedly in nature by crossing over within a sterility locus in a cross of sterile by wild-type homothallic, or by the pairing of hetero-allelic sterile mutants.

ONO, HUMIHIKO. Chromosome Breakage induced by Hybridization. *Department of Biology, Faculty of Science, Tokyo Metropolitan University, Tokyo, Japan.*

The intergeneric hybrid, *Paraixeris denticulata* ($n=5$) × *Lactuca squarrosa* ($n=9$) considering its parental chromosome numbers would be expected to have 14 choromosomes. But its karyotype fluctuates between 10 and 14 chromosomes (Ono, 1943). The cause of this phenomenon is considered to be fragmentation and elimination of paternal chromosomes in the maternal cytoplasm. Such a phenomenon is also observed in other hybrids, such as *Paraixeris denticulata* × *Crepidiastrum keiskeanum* ($n=5$), and *Crepidiastrum platyphyllum* ($n=5$) × *Lactuca squarrosa*. The eliminated chromosomes seem to be the paternal ones. Recent studies of natural hybrid swarms of *Paraixeris* and allied species have revealed that such fragmentation and elimination of the chromosomes takes place in nature as well (Ono, 1957).

There are some regularities in the mode of fragmentation. In the hybrid, *Paraixeris denticulata* × *Lactuca squarrosa*, among various karyotypes, cells with a definite karyotype with 12 chromosomes are most abundant. Among these 12 chromosomes 2 are very small ones, probably proximal parts of some larger chromosomes. B-chromosomes have appeared as the result of hybridization. The loss of these small chromosomes not being fatal for the individual, some have a balanced karyotype of 10 chromosomes.

To ascertain which chromosome has actually fragmented and at which point the breakage has occurred, analysis of minor karyotypes has been carried out. By placing the plants in a room at 0°C for 3 to 4 days, starvation of nucleic acid in chromosomes was induced. Such chromosomes reveal characteristic achromatic bands by which individual chromosomes can easily be identified. This analysis indicates that a chromosome with characteristic patterns tends to break more frequently than the others and further that a plant in nature with the seemingly standard chromosome number of 10 can be shown to be a mixture of groups with different patterns. It is even possible to trace the ancestry of the hybrid by means of such patterns.

Oshima, Chozo. The Resistance of Strains of *Drosophila melanogaster* to DDT and Dieldrin. *National Institute of Genetics, Misima, Japan.*

The strains of *Drosophila melanogaster* used in this experiment were started by different females captured in a single collection from each of several natural populations in Europe, Africa, Japan and United States. These strains have been cultured by mass-mating for about four years at Cold Spring Harbor and in Japan.

Forty female flies four or five days old, grown under optimal conditions, were exposed to DDT, Dieldrin or control test paper in a small vial. These test papers were prepared by the World Health Organization in Geneva. After exposure, flies were transferred into a fresh vial containing a wet paper and the number of dead flies was observed at definite intervals. Flies began to die by desiccation and starvation 25 hours after exposure to control paper.

The levels of DDT resistance in 18 strains of 10 localities were decided on the basis of percentages of accumulated mortalities 25 hours after exposure to 4% DDT test paper for 5, 10 or 15 hours. On the other hand, the levels of Dieldrin resistance in 11 strains of 5 localities were determined by percentages of accumulated mortalities 25 hours after exposure to 0.4 or 0.8% DL test paper for 0.5, 1.0, 2.0 or 3.5 hours. The several points showing each total average mortality of these strains at several time doses are nearly linear on normal logarithmic section paper. Resistance to both insecticides appears to be normally distributed in populations.

Eighteen strains were classified into three groups, non-resistant, slightly resistant, and resistant to DDT, and the numbers of dead flies at 25 hours after exposure to 4% DDT test paper for 15 hours were analysed statistically as to locality and strain. Highly significant differences in DDT-resistance between localities and between strains were found; the latter was larger than the former but not significantly so. Eleven strains were also classified into three groups, non-resistant, slightly resistant, and resistant to Dieldrin and the numbers of dead flies at 25 hours after exposure to 0.8% DL test paper for half hour were analysed statistically as to locality and strain. Highly significant differences in DL-resistance between localities and between strains were found once more, but in this case the former was significantly larger than the latter.

These results indicate conclusively that any local population is extremely heterogeneous in DDT and Dieldrin resistances; the locality-strain differences in the two cases may be attributed to different uses of the insecticides.

Oster, Irwin Isaac. Frequency-Dosage Relations for Mutations following X-Irradiation of Sensitive and Resistant Germ Cells. *Indiana University, Bloomington, Ind., U.S.A.*

Although many experiments have served to confirm Oliver's (1930) initial demonstration of the linear relation between the frequency of recessive lethal mutations induced by X-rays in sperm of *Drosophila* and the dosage of radiation used, it can be inferred from Auerbach's and Lüning's recent work that most, if not all, of the previous studies dealing with this problem involved the treatment of heterogeneous samples of germ cells. Since it is now well established that even the postmeiotic stages of spermatogenesis of *Drosophila* differ tremendously in their radiosensitivity and since knowledge of the relationship of lethal mutation frequency to dosage employed has a bearing on the interpretation of mutational mechanisms it was decided to reinvestigate this problem with the latest genetic techniques available. Homogeneous samples of the most radiosensitive and the most radioresistant stages of gametogenesis, represented by spermatids and oögonia, respectively, were treated. X-raying spermatids yielded 195/8,978 (i.e., lethals among tested chromosomes) for 250 r and 130/1,859 for 1,000 r, while the controls gave 19/2,392. This gives induced rates of 1.38 ± 0.24% and 6.20 ± 0.39%, indicating a linear relationship. The translocation frequencies obtained were 1.32 ± 0.20% (45/3,421) and 9.65 ± 0.75% (148/1,533), thereby showing a rise for these multi-break events proportional to $(\text{dose})^{1.4}$. Irradiation of oögonia in third instar larvae yielded 117/16,064 for 600 r and 33/2,056 for 2,400 r, while the controls gave 49/11,630. This gives induced rates of 0.31 ± 0.09% and 1.19 ± 0.30%, again a linear relationship. For equal doses, spermatid frequencies were 12 times oögonial frequencies. Special methods ruled out the presence of preexisting lethals as well as the inclusion of large clusters of mutations arising from one mutated cell by mitotic division. Thus at the dosages studied the strictly linear relation of lethal frequency to dosage employed was upheld for the most radiosensitive germ cells and extended to the least sensitive ones known in *Drosophila*.

(This work has been supported by a grant to Dr. H. J. Muller and associates from the U.S. Atomic Energy Commission, Contract AT(11–1)–195.)

PAIK, YONG KYUN. Seasonal Changes in *Drosophila* Populations in Two Adjacent Areas in Korea. *Laboratory of Genetics, Department of Biology, National Chunnam University, Kwangju, Korea.*

Seasonal changes in population size of *Drosophila* in South Korea had been checked over a period of a year, from July 1956 to June 1957. To confirm any areal nonhomogeneities in the distribution or seasonal changes of the species, two woodland areas were selected which are isolated from each other by a mountain, and which are about 700 meters apart.

A total of 12,918 flies was collected during the period in both areas. Area I provided 6,082 flies representing 27 sympatric species of which 19 belonged to the genus *Drosophila* and 8 to the other genera. In area II 6,836 flies were collected representing 25 sympatric species of which 16 belonged to the genus *Drosophila* and 8 to the other genera.

Changes in the total populations showed two sharp seasonal maxima in its size, one in the autumn (October-November) and the other in the spring (April) in both areas. Total population sank to an extremely low level, statistically zero in its size, during the cold winter months (December-February), which can be generally considered to be a severe "population bottle-neck period" in our climate. Total population also dwindled to the low level during the warm summer months (July-August). Total population changes from month to month through the year are also closely correlated with each other in both areas (R = 0.969).

Specific changes are also considered for 8 species which were abundant or common in the relative frequencies in the two populations. In both areas, *D. auraria*, *D. transversa* complex, *D. nigromaculata* and *D. cheda* complex showed two yearly maxima in autumn and spring: *D. bizonata* in winter and spring: *D. coracina*, *D. lutea* and *D. suzukii* peaks in spring, autumn and autumn respectively.

Specific fluctuations from month to month in both areas showed statistically a positive correlation between the same species.

D. bizonata is a representative species in these areas and has been continually collected throughout the year, even in months of severe cold (December-February) during which none of the other seven selected species was collected.

Deviations from a sex ratio of 50:50 have been examined for the 8 selected species. Comparing the results obtained in both areas, it may be noted that the deviation, in general, is statistically striking but is apparently species specific.

PALIWAL, R. L., and BEAL B. HYDE. The Association of a Single B-Chromosome with Male Sterility in *Plantago. Department of Plant Sciences, University of Oklahoma, Norman, Okla., U.S.A.*

Indian strains of *Plantago ovata* and *P. coronopus* contain a low percentage of completely male sterile plants. In male sterile *P. ovata* ($2n = 8$) meiosis proceeds normally, but the microspores later degenerate. To determine the nature of the sterility such male sterile plants were crossed with male fertile plants. Several generations of controlled crossing indicate that the sterility is cytoplasmic.

In *P. coronopus* our chromosome counts showed two karyotypes: $2n = 10$ and $2n = 10 + 1$. The odd chromosome in the $2n = 10 + 1$ type is shorter than, and does not pair with any other chromosome of the normal complement. Since it is almost entirely heterochromatic it may be considered a B-chromosome. The two strains are identical except that those containing B-chromosome are completely male sterile. The anthers never protrude from the flowers and seed set on bagged plants is negligible. At the first division of meiosis the B-chromosome does not lag behind and is incorporated into one of the daughter nuclei. The second division is normal, but the microspores degenerate.

The $2n = 10 + 1$ plants are apparently facultatively apomictic. Attempted crosses between male sterile *P. coronopus* and *P. amplexicaulis* ($2n = 10$) produced good seed set. All the plants in the "hybrid" progeny, however, resembled the female parent in all respects. Out of a total of 30 plants only one was male fertile and $2n = 10$, while the rest were male sterile and $2n = 10 + 1$. The single exception may have resulted from contamination of *P. amplexicaulis* pollen with that of *P. coronopus*.

This is the first case we are aware of in which male sterility may be attributed to the presence of a single B-chromosome.

PALIWAR, R. L. *See* HYDE, BEAL B.

PANDEY, KAMLA KANT. Microsporogenesis, Time of *S* Allele Action, Pollen Cytology and Place of Inhibition and Their Relationship with the Evolution of Gametophytic and Sporophytic Systems of Self-Incompatibility. *Department of Botany, Ohio State University, Columbus, Ohio, U.S.A.*

Self-incompatible plants have been variously subdivided into two groups according to some prominent characteristic. One that is based on the nature of the *S* gene action is composed of (1) gametophytic system—in which the reaction of the pollen is determined by the pollen genotype, and (2) sporophytic system—in which the reaction of the pollen is determined by the genotype of the mother plant. The basic difference between the two systems lies in the time of the *S* allele action. In the sporophytic system the *S* allele action takes place at least before anaphase I and in the gametophytic system at or following anaphase I. Pandey has suggested that the time of expression of *S* allele action in the sporophytic system is after anaphase II and may be either before the separation of the four microspores or after cytokinesis but before the development of exine. In the gametophytic system the time of expression is either after cytokinesis or after exine development. Since in the sporophytic species the microspore wall is laid down from the cytoplasm in which the *S* alleles have already expressed, the inhibition occurs at the contact of the pollen grain with the stigma which has correspondingly specific substances. In the gametophytic species the *S* allele action occurs internally in the individual microspores and thus inhibition in these species occurs after pollen germination when the specific substances of the pollen tube and the style are brought together.

The above hypothesis amounts to precocious nuclear activity in the sporophytic system. It is supported by the finding of Brewbaker who discovered that the gametophytic species had binucleate pollen grains, whereas the sporophytic species had trinucleate grains. However, there are several exceptions. The gramineaecious species are trinucleate, but three such species have the gametophytic system. All the self-incompatible heterostylous species have sporophytic system, but some of these species have binucleate grains. This hypotheses will be further discussed.

PARSONS, P. A. On the Phenomenon of Genetic Interference. *Department of Genetics, University of Cambridge, Cambridge, England.*

The phenomenon of genetic interference has been a topic of discussion and speculation ever since its discovery by Muller in 1916. In recent years a rational theory of genetic interference has been developed by Owen which was shown by him to fit existing *Drosophila melanogaster* data. Maize data examined in a similar manner agree with Owen's model, but the data are of insufficient accuracy to detect any minor deviations from it.

However, some recent linkage tests in the house mouse of more critical nature for linkage groups V and XIII show that modifications of the theory may be necessary. In both of these linkage groups there is a sex difference, the males exhibiting more intense interference than the females. This effect is most marked in linkage group XIII. Furthermore, on Owen's model, a recombination fraction greater than 50% would be expected between the extreme markers of linkage group XIII in the females, but this was not found. Such long chromosome arms are of extreme value in testing the validity of any metric.

It therefore appears that a different metric is needed for each sex, and possibly for each chromosome of the house mouse. Furthermore, variation in environment will act by changing the metric to a certain extent. Changes in the metric cause larger variations in recombination in the centromeric regions than elsewhere. This is supported by the effects of temperature and age on recombination in *Drosophila* both of which produce their effects in the centromeric regions.

PARTANEN, CARL R. The Quantification of a Tumorous Response to Ionizing Radiations in Fern Prothalli. *Children's Cancer Research Foundation, Boston, Mass., U.S.A.*

Tumors occur normally at a very low rate in the *in vitro* culture of certain fern prothalli, notably *Pteridium aquilinum.* This rate can be greatly increased by applying an optimal dose of ionizing radiations, either to actively growing prothalli or to dormant spores. This system presents a unique opportunity for the analysis of factors involved in the process of tumorization since the response occurs in a haploid organism *in vitro* on completely defined media in a readily controlled physical environment. The primary causal event is known to occur in a single cell and appears to be a mutation. The radiation effect persists in dormant spores over long periods of storage prior to germination. Further, this process lends itself readily to quantitative analysis since spores can be irradiated in quantity and then sown in known amounts. Work to date has consisted primarily of developing rather precise quantitative techniques in which the exact size of the inoculum is known and also the absolute number of viables can be determined to a high degree of accuracy. Present studies are directed towards the determination of the dosage-response relationships and also towards the screening for substances which may in any way alter the tumor response to radiations. Preliminary results indicate that a linear relationship exists between the amount of radiation and the resultant number of tumors, for doses up to 16,000 r.

PAVLOVSKY, O. *See* BEARDMORE, J. A.

PELC, S. R. *See* LA COUR, L. F.

PENHA, A. M. *See* SCHREIBER, GIORGIO, *et al.*

PEREGRINE, W. T. H. *See* GRIFFITHS, D. J.

PERKINS, DAVID D. Crossing-over in Linkage Group I of *Neurospora. Department of Biological Sciences, Stanford University, Stanford, Calif., U.S.A.*

The discovery of new loci has extended the arms of linkage group I of *Neurospora crassa* in both directions to a total length exceeding 125 units, within which about thirty useful markers have been mapped. The following information has been obtained by analysing random segregants and tetrads from multiple point crosses. Chiasma interference is positive for neighboring short regions, at least within the range of interval lengths examined, where recombination frequencies are such that non-selective analysis is practical. The intensity of interference is similar in the right arm of group I in *Neurospora* and in the X-chromosome of *Drosophila* *melanogaster*, which is of about the same genetic length. Post-reduction of alleles at loci increasingly far from the centromere (as determined from tetratype frequencies with respect to a centromere marker) increases to a maximum value greater than two-thirds, and then declines so as to approach this random limiting value at distances beyond the maximum. This is the pattern that would be expected to result from positive chiasma interference. Crossover frequencies are highly variable for similar intervals in crosses of different parentage. Because of these variations of intrinsic origin, conclusions regarding gene order may be unreliable if based on 2-point rather than on 3-point tests. (This work has been supported by grant E1462 from the National Institute of Allergy and Infectious Diseases, U. S. Public Health Service.)

PERLIN, SEYMOUR, and GORDON ALLEN. Designed Genetic Bias in a Schizophrenic Sample. *National Institute of Mental Health, Bethesda, Maryland, U.S.A.*

For a disease that is etiologically diverse, the best clues to pathogenesis may come from biased samples. A sample may be usefully biased by restriction to part of the diseased population, but for some purposes a bias in the opposite direction is better, bringing in all sub-types of the disease regardless of their relative frequency. This is true in the screening of new tests in the hope that one will detect a gross biochemical defect related to some form of the disease under study.

If schizophrenia is etiologically diverse, cases with a simple genetic cause are the ones most likely to have underlying gross chemical pathology. In planning the selection of 16 schizophrenic patients for intensive biochemical investigations, we decided that the widest sampling of genetic causes would be achieved if one-fourth showed a family history suggesting dominance; one-fourth, a history suggesting recessiveness, and one-half, a negative family history. We reasoned that any common genetic type would be certain to occur among the patients with affected close relatives, but that any possible semi-lethal dominant or rare recessive type might be crowded out of these groups if much schizophrenia is due to a common dominant defect, to polygenes, or to social causes. The patients with negative family history would then be more likely to include an uncommon genetic type, and they could, by design, also include any distinct clinical types not found in the first half of the sample.

PERRY, T. O. *See*, WANG, CHI-WU.

PERSON, CLAYTON. A Study of Asynapsis and Its Effect on Subsequent Chromosome Behavior. *Canada Department of Agriculture Research Laboratory,* and *University of Manitoba, Winnipeg, Man., Canada.*

From earliest prophase onward the chromosomes in meiotic cells of a barley plant (*Hordeum vulgare* L., $2n = 14$) remained unpaired. At the stage corresponding to metaphase of first meiosis quasibivalents were not found and, for those cells in which poleward movements of the univalents had taken place, the distribution of univalents was random. These observations support the author's earlier conclusions, first, on the processes leading to the formation of quasibivalents and second, on the effect of quasibivalents, when present, on the polar distribution of univalents.

PETERS, H. F. Hybridization of Domestic Beef Cattle and American Bison. *Canada Range Experimental Farm, Manyberries, Alberta, Canada.*

In 1915 the Canada Department of Agriculture began a project to develop a range beef animal for western and northwestern Canada that would combine some of the hardy characteristics of the American bison and the meat qualities of domestic beef cattle. The experiment was conducted at Wainwright, Alberta, until 1950, when the herd was moved to the Range Experimental Farm, Manyberries, Alberta. The project is being continued at Manyberries with a herd of 130 cows of ½-bison to $\frac{1}{16}$-bison breeding.

Male sterility has prevented the development of a breed of Cattalo. No fertile first-cross bulls were obtained. Semen from ⅛-bison to ¼-bison bulls varies in quality from complete absence of spermatozoa to normal concentration and a small proportion of the bulls show varying degrees of fertility. The cause of sterility has not been determined.

A study of foraging performance of beef cows on winter range in 1951–2 showed that the Cattalo foraged on upland open range more frequently than the cows of domestic breeds. Also, a greater proportion of Cattalo cows were out foraging as compared with cows of domestic breeds. The amount of foraging on upland range (as opposed to sheltered coulees) increased significantly with increase in temperature, and decrease in wind mileage, and amount of supplemental feed. Temperature was the most important of environmental factors, wind mileage and amount of supplemental feeding having a significant effect only at low temperatures.

In feedlot studies during 1952–3 and 1956–7, Cattalo calves made significantly greater feedlot gains than bison and lower gains than Herefords. Progressively lower carcass grades, lower proportions of carcass weight in the hindquarters, and an increase in dressing percentage were obtained as the proportion of bison breeding increased.

PETERSEN, J. A. *See* CORDEIRO, A. R.

PFAHLER, PAUL L. and JULES JANICK. A Proposed Method for the Determination of Dominance Levels. *Purdue University, Department of Horticulture, West Lafayette, Indiana, U.S.A.*

A method to determine the level of dominance by the use of euploidy and aneuploidy is proposed. If tetraploids can be produced artificially from homozygous diploid inbreds AA and BB, the triploids, AAA, BBB, AAB and ABB, could be synthesized from appropriate crosses. The mean of the triploid hybrid AAB can be partitioned into three main effects: (1) the mean of the diploid hybrid, AB; (2) the effect of triploidy, 2(AAA-AA) + (BBB-BB)/3; (3) any effect designated I^{gA}, brought about by the additional A genome. The I^{gA} value can be estimated by the following equation, $I^{gA} = AAB\text{-}AB\text{-}[2(AAA\text{-}AA) + (BBB\text{-}BB)/3]$. The I^{gB} value for the triploid hybrid ABB can be estimated similarly. The level of dominance can be estimated by a comparison of the sign and magnitude of the I^{gA} and I^{gB} values. If the mean of the diploid hybrid AB were within the range of both parental means indicating additive or partially dominant gene action, the sign of I^{gA} and the I^{gB} values would be positive. The difference between the I^{g} values would indicate a difference in the contribution of dominant alleles from each parent. If the mean of the diploid hybrid AB were as large or larger than either parent, dominant or overdominant gene action would be operative. If gene action were dominant, the I^{gA} and the I^{gB} values would be zero. If gene action were overdominant owing to divergent physiological function of alleles, the I^{gA} and the I^{gB} values would be positive. If the gene action were overdominant owing to optimum level of gene product, the I^{gA} and I^{gB} values would be negative. If the production of trisomics were possible, a similar analysis could be employed to partition the I^{g} effect into individual chromosomal components. The results obtained by this method would not be influenced by epistasis or linkage.

PHILIP, URSULA. Genetics and Cytology of the Seaweed Fly, *Coelopa frigida* (F). *Department of Zoology, King's College, University of Durham, Newcastle upon Tyne, England.*

Coelopa frigida (F) is a fly living in wrack beds, which are periodically thrown up by the sea. This specialised ecological niche gives the unique opportunity to investigate the genetic structure of a species, the distribution of which is almost strictly linear. During the last years my collaborators and I have been studying the biology, cytology, and genetics of this fly.

Coelopa frigida has a life cycle of 12 days at 25°. The eggs are laid in batches of approximately 80. There is, as a rule, a high percentage of hatch. The animals show a great deal of variability in response to environmental conditions. The three varieties described in the systematic literature are produced according to the amount of food available during larval development. The sex ratio is of great interest. The primary sex ratio, estimated from batches of flies, where mortality between egg and imago was very low, is approximately .5 with a variance much below what would be expected by chance. With rising death rate due to over-population the variance increases. In cultures with gross over-population there is a significant deficiency of males.

We have five stocks with visible mutants; "white eye," "sherry eye," "cut wing," and "chopped bristles" were collected from free living populations, the dominant "Delta" from laboratory cultures. No sex-linked mutants have been found. Three egg lethals have repeatedly been isolated from one free living population. One lethal causes death at an early stage, one at the time of the involution of the head, and a third one at the time of eclosion. The Delta homozygote dies after faulty cleavage at the end of gastrulation.

Investigations of the salivary gland chromosomes have shown three populations to be heterozygous for multiple inversions.

PIPKIN, SARAH BEDICHEK. A Study of Male-Determining Regions of Chromosome 3, *Drosophila melanogaster. Howard University, Washington, D.C., U.S.A.*

A search was made for male-determining regions of chromosome 3 in *Drosophila melanogaster.* Males heterozygous for either one or two 3,4 translocations were crossed with homozygous y^2; ru ca triploids. Recessive markers in the male parents allowed the detection of hyperintersexes (2X3A + fragment of 3), hypointersexes (2X3A — fragment of 3), and other aneuploid progeny. The distribution of Dobzhansky's six intersex sex types in hyperintersexes has been studied in nine short regions of chromosome 3. Experiments were carried out at 22° ± 0.5°C. Chi square homogeneity tests were made on the frequencies of sex types of control intersexes hatching in different bottles with the same male parent composition. Where such frequencies proved homogeneous (nearly always), they were pooled. Hence a comparison of these pooled sex type frequencies of control 2X3A and hyperintersexes of the same cross reveals a sex shift (or lack of it) due to the presence of the extra fragment rather than to that of the genetic modifiers. A significant shift towards maleness in hyperintersexes was found in 4 regions, 3 of which overlap: (1) region c–89E (in salivaries, between 86D and 89E), mean sex type of hyperintersexes, 1.3409 ± 0.072, of control 1.6993 ± 0.061; (2) region 2R (from end of 94A to end of chromosome), mean of hyperintersexes, 1.2449 ± 0.073, of control intersexes, 1.9933 ± 0.051; (3) region 30R (from end of 96F to end of chromosome), mean of hyperintersexes, 1.4350 ± 0.065, of control intersexes, 2.2560 ± 0.071; (4) region H5R (from point intermediate between 94A and 96F to end of chromosome), mean of hyperintersexes 1.1905 ± 0.084, mean of control, 1.9535 ± 0.090. No shift of intersex sex types in hyperintersexes as compared with their control 2X3A was found in the four regions analysed statistically: 89E-28 (between 89E and 92E); 85C-c (between 85C and 86D); 12–13 (between 67F and 73C); 28–2 (between 92E and end of 94A). No shifts towards femaleness existed in any of the hypointersexes found for regions 28-2, 85C-c, 12-13, c-89E, 85C-89E, and 89E-28. No intersexuality was found in the hypertriploid females (3X3A + fragment of 3) which survived for all regions.

PITTENGER, THAD H. Mitotic Instability of Pseudo-Wild Types in *Neurospora. Oak Ridge National Laboratories, Milwaukee, Wis., U.S.A.*

In *Neurospora* it is known that phenotypically wild-type progeny from crosses of closely linked mutants are not always recombinants, but some appear to originate from n + 1 nuclei. Such disomic nuclei are unstable and by some post-meiotic process give rise to genetically different haploid nuclei. These strains are then heterokaryotic and are referred to as pseudo-wild types (PWT). In an attempt to localize the time and to characterize the mechanism involved in the mitotic breakdown of disomic nuclei, an analysis was made of the nuclear ratios present in mycelia derived from two or more individual hyphae just emerged from opposite ends of PWT ascospores from a cross of *lys*-3 × *nic*-2, *al*-2. Although a wide range (0-100%) exists in the proportion of *lys*-3 nuclei that can be found in the hyphae emerging from a disomic ascospore, there is a high positive correlation between the proportion of *lys*-3 nuclei found in the hyphae from opposite ends of a spore and this is similar to the correlation between the nuclear proportions in different hyphae from the same end of a spore. This high correlation suggests that these proportions are established in the spores prior to the emergence of the hyphae. Since reduction must precede any inequality in the proportion of the two nuclear types, it is concluded that reduction takes place during early nuclear division inside of the ascospore. That it is very often, but not always, the first nuclear division within the ascospore that is abnormal is shown by a comparison of the frequency of PWTs and recombinant wild types in irradiated and non-irradiated populations. In populations in which the number of viable nuclei per spore had been effectively reduced from two to one by X-irradiation, the proportion of phenotypically wild types which were PWTs was significantly reduced, suggesting that many binucleate PWT spores were already heterokaryotic.

PIZA, S. DE TOLEDO. A Note on the Chromosomes of an Elaterid Beetle. *Esc. Sup. de Agricultura "Luiz de Queiroz," Universidade de S. Paulo, Brazil.*

The following observations have been made in the course of a study of male meiosis in the elaterid beetle *Pyrophorus nyctophanus* (Germ.).

The spermagonia have fifteen chromosomes of different sizes, the longest ones being clearly curved. The smallest element seen at metaphase is, quite probably, the sex chromosome. Primary spermatocytes exhibit at metaphase 7 dumbbell-shaped tetrads and a relatively small sex chromosome. Some bivalents, consisting of two chromosomes joined by what used to be considered a terminal chiasma, show at diplotene-diakinesis in each chromosome a median constriction, and despite that never formed ring-tetrads. Moreover, tetrads, which by their size correspond to the largest, curved and probably metacentric spermatogonial chromosomes, sometimes appear clearly quadripartite at metaphase, the two chromatids at each side of the equator, in disagreement with their metacentric condition, showing tapering ends independently connected with the corresponding pole. The sex chromosome passes undivided to one pole in the first division, so that secondary spermatocytes with 7 and 8 (7A + X) chromosomes have been found.

The author concludes that, if we admit that the median constrictions seen in bivalents at diakinesis do not represent centromeres and that division of the chromosomes into their chromatids takes place prior to pairing, the absence of ring-tetrads, and other peculiarities of elaterid meiosis will be satisfactorily explained.

PLOUGH, HAROLD H. *See* ROBERTS, MARGARET R.

PODDUBNAYA-ARNOLDI, V. A. Study of the Fertilization Process in Certain Angiosperms on Living Material. *Main Botanical Garden of the Academy of Sciences, Moscow, U.S.S.R.*

After the papers of Strasburger (1900) and Shibata (1902) on the fertilization in *Monotropa hypopitys* and *M. uniflora* no data on the study of this process on living material were to be found in literature. To fill up this gap the author has studied fertilization and the processes connected with it in *Cypripedium insigne*, *Calanthe Veitchii* and *Dendrobium nobile* on living material. Comparison of the formation of gametophytes and gametes, and of fertilization observed on living and fixed material shows them to be very similar. Along with this fact, vital study enabled the elucidation of a number of details which could not be studied at all or could not be seen clearly enough on fixed material.

The presence of chondriosomes and colourless plastids was observed at different developmental stages of the pollen and ovule, micro- and macrospores, male and female gametes, as well as zygotes. The author concludes therefore that plastids and chondriosomes are the sites of synthesis of different plastic, physiologically active substances and enzymes. In pollen tubes "stoppers" were found which prevent the distribution of nutritive and energizing substances throughout the length of the tube stimulating their concentration at the tip of the pollen tube.

When localization and dynamics of different plastic substances in pollen, pollen tubes, embryo sacs and gametes were studied, a high fat content was found, particularly at the time of pollination and fertilization. This phenomenon may be connected with the fact that fat is not only a trophical substance but a solvent of carotinoides as well. The carotinoides appear to play an important part in generative process.

As progress in the study of fertilization on living material is as yet insufficient, further improvement of vital methods and selection of the most suitable objects of study are needed, particularly with respect to the fusion of the gametes.

POND, VIRGINIA. *See* WILSON, G. B.

PONS, JOSÉ. Quantitative Genetics of Human Dermatoglyphics: Frequency Distributions and Sib Pair Correlations of Palmar Main Lines Transverseness. *Instituto "Bernardino de Sahagún" de Antropología y Etnología, Barcelona, Spain.*

The general course of the main lines on the palm shows a variable approach to the transverse direction, i.e., the lines exhibit a greater or lesser degree of obliquity. Racial differences are found in this trait, and there is no doubt that it is inherited. In this paper we consider the problem of the quantitative expression of the degree of obliquity of palmar main lines, analysing their distribution and the deviations from normality. At the same time we consider the heritability by calculating the intraclass correlation among sibs.

A sample consisting of 400 Spaniards (200 ♂ and 200 ♀) shows a small negative skewness which is not significant, and a greater platykurtosis for the considered trait. The intraclass correlation among sibs, using data from 113 sibships with 286 members, is near 0.5, the theoretical value when additive genes with independent effect are present.

POULSON, D. F. *See* MALOGOLOWKIN, CHANA; KANEHISA, T.

PRAKKEN, R., and J. H. VAN DER VEEN. Flower Variegation and Seed Quality in *Nicotiana tabacum. Laboratory of Genetics, Agricultural University, Wageningen, The Netherlands.*

In F_2 of the cross between two pink-flowered varieties of *Nicotiana tabacum* about $\frac{1}{16}$ of the plants showed white-(pale) pink variegated flowers, together with bad, shrivelled seed. On selfing this pink variegated type and crossing it to both parents, it proved to be double recessive, vp1vp1 vp2vp2 (vp = variegated pale), the parents being Vp1Vp1 vp2vp2 and vp1vp1 Vp2Vp2.

Carmine colour (Pk) is dominant over pink (pk). The cross of carmine unicoloured with pink variegated, F_1 carmine, gave F_2 segregation (1,228 plants) into 45 carmine unicoloured: 3 carmine variegated: 15 pink unicoloured: 1 pink variegated, demonstrating for the carmine parent the genotype PkPk Vp1Vp1 Vp2Vp2.

A recessive white type (wh) appeared to be whwh PkPk Vp1Vp1 Vp2Vp2, versus WhWh pkpk vp1vp1 vp2vp2 of pink variegated.

The carmine variegated plants show a very large range of variation in number and size of the coloured or white spots and in intensity of colour. Different types of variegation may occur in one plant often in separate sectors, varying from small within flower sectors to distinct within plant sectors. Sharp classification has hitherto not been possible.

By rough estimation a colour-value was given to each carmine variegated plant, from 1 (almost white) to 9 (almost carmine), 10 being reserved for carmine unicoloured. In one experiment a sample of 21 carmine variegated plants, with colour-values from 1 to 9, gave offspring with mean family values from ± 3 to 7, clearly showing positive parent-offspring correlation, possibly discontinuous. Moreover, plants with values 6, 7, 8 and 9 gave a few carmine unicoloured (value 10) offspring; these carmines always gave similar offspring as related variegated plants; root cuttings produce but variegated plants.

From clearly sectorial plants dark and pale sectors (pairs of values 10–6, 10–5, 10–4, 6–3, 6–3, 5–3, 5–2, 5–2) were selfed. The resulting offspring gave no indication of positive correlation between parent sector value and mean offspring value.

In the carmine variegated type the relation between colour-value and seed quality was studied carefully: a strong positive correlation was found in individual flowers, plant sectors and plants. Recessive white plants (whwh) of the vp1vp1 vp2vp2 genotype can be recognized by their shrivelled seeds.

PREVOSTI, ANTONIO. Inversion Heterozygosity and Selection for Wing Length in *Drosophila subobscura. Centro de Genética Animal y Humana, Universidad, Barcelona, Spain.*

To obtain information about the structure of the genotype controlling adaptive traits, e.g., wing size (Prevosti, 1954, 1955) and to get some insight into the meaning of chromosomal polymorphism in relation to this point, the following experiment was carried out. Two lines of artificial selection were made of one stock of *D. subobscura*: one line selected for long wings, and the other for short wings. In the starting populations (F_1 reared in the laboratory of 25 wild flies of a natural population) the mean number of chromosome inversions per individual was 3.65. After 9 generations of selection the line selected for long wings had 3.80 inversions per individual and a sample of a control line 3.52.

The differences between these values cannot be interpreted as an increase of inversion number due to selection, since they do not exceed the expected sampling error. On the other hand the change is clear in the short wings line in which chromosomal homozygosity is virtually reached. In 25 individuals observed only one inversion was found—in the chromosome X. Two other lines of selection are being studied and are showing the same trend.

A comparison is made of these results with the changes in the selected trait and other correlated responses (especially in fertility and viability) obtained in these and other lines (Prevosti, 1956, 1958). We infer that the inverted segments of the chromosomes act in the same way as supergenes, in which the factors controlling size, viability and fertility are coordinated and give compound dominance of long over short wings and, probably, heterosis in viability and fertility. In this way chromosomal polymorphism represents a mechanism evolved to stabilize the coordination of a genotype adapted, in which heterosis has an important role.

PRIADCENCU, AL., I. TARNASKI, A. MELACRINOS, D. MELBER et E. BOLDEA. Quelques formes nouvelles de plantes obtenues par des croisements eloignés entre céréales. *Bucharest, Romania.*

Les croisements éloignés entre différents genres et différentes espèces de plantes donnent, par ségrégation, de nouvelles formes d'hybrides stables possédant certains caractères et des qualités des deux parents dont ils proviennent.

En 1938, plusieurs variétés de blé d'automne ont été croisées avec deux variétés de blé durum. Par sélection, nous avons réussi à isoler des générations avancées un hybride stable, nommé *speltoïde.* Le nombre $2n$ du speltoïde est de 35 chromosomes. A la métaphase de la division I, on observe généralement 17 bivalents plus 1 univalent. Les irrégularités observées au cours de toute la méïose ne se chiffrent qu'à 2.4%. Les caractères caryologiques de cet hybride semblent en voie de se stabiliser.

Entre 1939 et 1944, nous avons croisé 40 variétés et populations de blé d'automne avec la variété *Petkus* de seigle d'automne. Les hybrides de la F_1 sont bien développés mais stériles. Par rétrocroisements avec le blé et le seigle nous avons finalement obtenu un hybride stable et fertile que nous avons désigné *Néo-Sécalotriticum.* Son nombre $2n$ est de 56 chromosomes et à la métaphase I il possède 28 bivalents. C'est donc un amphidiploïde.

De 1937 à 1942 nous avons aussi croisé des espèces d'*Aegilops*, de *Triticum* et de *Sécale.* Un hybride de F_1 de *T. vulgare erythrospermum* × *T. durum* var. *valenciae* croisé à *A. ovata* nous a finalement donné un hybride stable désigné *Néo-Aegilotriticum.* Son nombre $2n$ est seulement de 42 chromosomes et il peut être considéré comme un triploïde.

Ces plantes n'ont pas d'importance économique. Elles sont cependant très utiles en amélioration des plantes et sont aussi d'un très grand intérêt scientifique.

PRICE, SAM. Chromosome Numbers Transmitted by *Saccharum officinarum. Crops Research Division, Agricultural Research Service, U.S. Department of Agriculture, Beltsville, Maryland, U.S.A.*

"Triploid" individuals have rarely, if ever, been found in *Saccharum officinarum*

L., yet hybrids from *S. officinarum* L. × *S. spontaneum* L. have almost always had chromosome numbers that are the sum of their maternal diploid and paternal haploid numbers ($2n + n$). However, these observations have come largely from attractive individuals, selected and maintained in sugar-cane breeders' collections.

For unbiased information unselected progeny were studied. Of 94 individuals from intraspecific crosses with *S. officinarum* ($n = 40$), 93 had 80 chromosomes ($n + n$) and one (with $2n = 79$) was an aneuploid of the $n + n$ type. Of 100 hybrids from *S. officinarum* ($n = 40$) × *S. spontaneum* ($n = 32$), all had 112 chromosomes ($2n + n$). Of 27 *S. officinarum* ($n = 40$) × *S. spontaneum* ($n = 40$) hybrids, 26 had 120 chromosomes ($2n + n$), but one had 80 chromosomes, the $n + n$ number. Of 32 hybrids from *S. officinarum* ($n = 40$ × *S. spontaneum* ($n = 56$), 31 had 136 chromosomes ($2n + n$) and one (with $2n = 130$) was an aneuploid of the $2n + n$ type. Of 24 *S. officinarum* ($n = 40$) × *S. spontaneum* ($n = 64$) hybrids all were found to have 144 chromosomes ($2n + n$).

Observations upon unselected progeny agree with earlier results. In intraspecific crosses, *S. officinarum* rarely, if ever, transmits its diploid number maternally. Conversely, the same species rarely transmits its expected gametic chromosome number maternally when crossed with *S. spontaneum*.

If both n and $2n$ eggs are present in *S. officinarum* at the time of fertilization, selective fertilization and/or differential survival must be almost completely effective in eliminating "triploids" on the one hand and $n + n$ hybrids on the other. An alternative hypothesis might be the failure of egg and sperm nuclei to enter synchronously into the first division of hybrid zygotes.

PRITCHARD, R. H. Recombination and Negative Interference in *Aspergillus nidulans*. *Department of Genetics, University of Glasgow, Glasgow, Scotland.*

The use of selective techniques in a number of organisms has permitted an analysis of the properties of recombination in extremely short genetic intervals. In *Aspergillus nidulans* it is clear that, even between alleles, recombination is normally a reciprocal process. There is no evidence that intragenic recombination is of a different kind from intergenic recombination (Beadle, 1957), nor can gene conversion account for more than a small minority of intra-genic recombinants (for exceptions see Strickland, 1958).

On the other hand, localised negative interference, resulting in coincidence values of over 100 in some cases, is a normal feature of recombination in *Aspergillus* (Pritchard, 1955; and unpublished). This interference is only apparent between adjacent intervals the combined length of which is not more than a few tenths of a map unit.

The following hypothesis accounts satisfactorily for the data from *Aspergillus* and similar observations in other organisms. In any one cell the necessary conditions (effective pairing) for recombination are restricted to very short, discontinuously distributed segments of the genetic material. In a population of cells these segments will be distributed over the whole genome. Coincidence values greater than unity will be obtained for two adjacent intervals whose combined length is not much greater than the mean length of effectively paired segments since in most cells neither interval will be effectively paired, but when one interval is effectively paired, the effective pairing segment will usually cover both intervals, leading to a positive correlation between exchanges in the two intervals.

The recombination fraction between markers relatively far apart will depend on the frequency of effective pairing in the interval, and the frequency of exchanges within effectively paired segments. Interference operative over long intervals would result if effective pairing at one point influenced the probability of effective pairing elsewhere.

In *Aspergillus* preliminary data indicate that effective pairing segments are variable in length with a mean of about 0.3 map units. The mean number of exchanges per segment is between 1 and 2. The location of the segments is variable but may not be random.

PROKOFIEVA-BELGOVSKAYA, ALEXANDRA, in collaboration with V. N. BELIAEVA, D. D. ROMASHOV, N. N. ROTT, A. A. NEUFACH, and K. A. GOLOVINSKAYA.

The Action of Ionizing Radiation on the Cell Nucleus in Early Development of Fishes.

Institute of Biophysics and Institute of Animal Morphology, Academy of Sciences of the USSR; Institute of Pond Fishery, RSFSR., Moscow, U.S.S.R.

The problem of radiosensitivity of the early stages of fish development was investigated on the embryos of *Misgurnus fossilis, Acipenser stellatus, Salmo salar*, and *Cyprinus carpio*. Sperms, egg cells, and developing eggs through the stages from the first cleavage division to the late gastrula were treated with X-ray doses 50 r to 200,000 r. The radiosensitivity of the embryos was characterized by the degree of damage to cell nuclei (chromosome rearrangements), the mitotic index, survival percentage and percentage of monstrosities among the fry hatched. The degree of damage to the cell nuclei of the developing embryo depends upon the dose of radiation, the phase of mitotic cycle and the stage of development treated.

The parental chromosome sets in the blastomeres are spatially disconnected and differ up to the blastula stage as to the rate of cyclic changes during mitosis, the DNA content, the degree of basophily, and the ability to synthesise the nucleolus. The independence and the dissimilarity of cycles of development of the parental chromosomes lead to the specificity of radiation damage to the cell nuclei of blastomeres of the segmenting egg: doses up to 800 r affect preferentially one of the two chromosome sets of the nucleus.

The periodical changes in embryo radiosensitivity reflect the differences in radiosensitivity of the cell nucleus at different phases of mitosis during the period of synchronous cleavage divisions (till the early blastula stage). The degree of the damage to the cell nuclei, the number of nuclei affected and correspondingly the percentage of embryonic deaths increase progressively as the blastomeres pass from the interphase through the prophase to the metaphase. At the most sensitive phase of mitosis of the second cleavage division (2–4 blastomeres) a dose as small as 50 r causes a significant number of chromosome rearrangements (5.5% of bridges as contrasted with 0.8% in control). The early blastula stage is more sensitive than the late one.

Heavy doses of X-rays (10,000–50,000 r) were used in order to investigate the dependence of manifestation of the radiation damage upon the stage of development. When the embryo in its development reaches the period of slowed down and asynchronous divisions (early and middle blastula), its reaction on the treatment with heavy doses changes: irradiation before the early blastula stage leads to an arrest of development before the beginning of gastrulation, while a treatment after the early blastula stage does not interfere with the process of gastrulation and the latter goes to the end. Correspondingly the time of the death of the embryo is shifted.

Different types of chromosome rearrangements persist through many cell generations and may be traced to the gastrula stage. There exists a clear dependence of the survival percentage and the frequency of appearance of monstrous embryos upon the degree of damage caused to the cell nuclei.

PUCK, THEODORE T. Genetic Studies on Somatic Mammalian Cells. *Department of Biophysics, University of Colorado Medical Center, Denver, Col., U.S.A.*

Simple methods for plating single mammalian cells on petri dishes so as to produce quantitative growth of discrete, macroscopic colonies have been developed. Clones of mammalian cells from a variety of normal and malignant, human and animal tissues have been isolated. In collaboration with Dr. J. H. Tjio, a rapid method of chromosome delineation, particularly suited to these preparations, has been developed and applied to cultured human cells with karyotypes containing 78 and 46 chromosomes and to opossum and Chinese hamster cells with 22 chromosomes. A defined medium with two purified protein constituents has been found which promotes quantitative growth of single cells of some types into colonies of any desired size. Naturally occurring mutant clones have been isolated with nutritional, virus-resistant, and chromosomal-morphologic markers which have remained stable throughout hundreds of generations. X-ray survival curves have been constructed, most of which approximate 2-hit character, and mean lethal doses for the cell reproductive function were measured and found to lie in the range of 60–150 r. A variety of evidence demonstrates that the destruction of cellular reproductive capacity by X-rays is due primarily to chromosomal damage. Several types of chromosome abnormalities are produced by X-irradiation even at and below doses of 25 r. Mutants with characteristic chromosomal constitution and nutritional behaviour have been isolated from X-ray survivors. Quantitative data on the radiogenetic damage to single cells will be presented and applied to interpretation of various mammalian radiobiological actions.

QUELCE-SALGADO, A. *See* FREIRE-MAIA, A.

QUINTANILHA, A. Mendelism and Michurinism. *Centro de Investigação Cientifica Algodoeira, Lisboa, Portugal.*

Michurinism is a biological theory elaborated by Lysenko in the name of Michurin and essentially characterized by the following principles: (1) denial of the existence of cellular material particles responsible for the transmission of hereditary characters; (2) negation of the continuity of the germinal plasma; (3) acceptance of the principle of inheritance of acquired characters; (4) denial of the existence of a struggle for life among the members of each biological population, responsible for the natural selection.

The author intends to prove that: Michurin himself was not a Michurinist in the sense of Lysenko—Michurin's most important horticultural successes were obtained by the use of Mendelian methods; the materialist doctrine of the existence of cellular particles responsible for the transmission of hereditary characters is fully demonstrated; the continuity of germinal plasma is not a theory but a biological fact; the inheritance of acquired characters is in disagreement with any experiments intended to prove it; the rejection of the struggle for life as an explanation of natural selection is a misunderstanding—some Soviet biologists feared that, if we admit the existence of the struggle for life as a natural fact in animal societies, we have to accept the principle of competition among individuals of human societies as a normal and inevitable consequence.

RAMEL, CLAES O. M. O. Studies on Interchromosomal Effects of Inversions in *Drosophila melanogaster. Institute of Genetics, University of Stockholm, Stockholm, Sweden.*

The interchromosomal effect of inversions on crossing over seems to merit further invesigations as it might be a useful approach to the evaluation of the mechanism of crossing over. In this investigation the following points have been studied.

(1) A comparison was made of the effect of homozygous and heterozygous Muller 5 inversions in the X on crossing over in the second chromosome. The effect of heterozygous Muller 5 agreed with the results previously found for the interchromosomal effect of other X chromosome inversions on crossing over in the second chromosome, i.e., an increase chiefly in the vicinity of the centromere and an increase of multiple crossovers. Homozygous Muller 5 on the contrary showed only a slight effect compared to the control.

(2) In the Muller 5 chromosome the proximal heterochromatin has been displaced to the distal end. A study of the effect of autosomal inversions on crossing over in the distal end of homozygous Muller 5 was made. The increase of crossing over in this region in the presence of autosomal inversions did not show the characteristics of the corresponding increase in the distal part of a standard X chromosome but rather of the proximal part. This seems to indicate a direct effect of the inversions on the heterochromatic region.

(3) The influence of autosomal inversions on reversion of Bar did not give any evidence of clusters, pointing to gonial crossing over.

RAPER, JOHN R. The Genetics of Incompatibility in *Schizophyllum commune. Biological Laboratories, Harvard University, Cambridge, Mass., U.S.A.*

In the tetrapolar Hymenomycetes, sexual fertility of homokorgotic strains depends upon heterozygosity of two incompatible factors, *A* and *B*. A world-wide sample of 114 homokaryotic strains of *Schizophyllum commune* contained 96 distinct and interfertile *A* factors and 56 different *B* factors. Specific factors of each incompatibility series, *A* and *B*, appear to be equally frequent in the natural population and to be randomly distributed in respect to geographical and climatic location. These facts indicate 339 (5% limits of 562 and 216) *A* factors and 64 (5% limits of 79 and 53) *B* factors and an outcrossing efficiency of 98.15% in the natural population.

The *A* factor comprises two sub-units separable by crossing-over; recombination between component sub-units of paired *A* factors yields two new classes of factors per cross that are (*a*) interfertile, (*b*) interfertile with both parental factors, and (*c*) often identifiable with factors collected from nature. In most pairings recombination frequency is between 3% and 6% at 23°C and is strongly affected by temperature. No distinction has been found in the action of the two sub-units: in respect to the *A* factor, strains are completely compatible when heterozygous for either sub-unit or heterozygous for both; incompatibility results only when both sub-units are homozygous.

Less extensive tests with the *B* factor show it to be comparable to the *A* factor in structure and in the inter-relationships of its components. Recombination between sub-units of the *B* factor has not been found in excess of 3%.

The nature of the individual sub-unit remains in doubt. Each may represent multiple alleles at a single locus or a number of very closely linked loci.

RASMUSEN, BENJAMIN A., CLYDE STORMONT, and YOSHIKO SUZUKI. Blood Groups in Sheep. *School of Veterinary Medicine, University of California, Davis, Calif., U.S.A.*

Several papers now in press and in preparation by the present authors are concerned with evidence for six genetic systems of blood groups in sheep in addition to the earlier recognized R-O system. These systems are named A, B, C, D, M, and X-Z, and the present note is intended to serve as a summary-statement of their essential features. The A system presently comprises a single pair of phenogroups, A as contrasted with no-A, and A antibodies are regularly engendered in isoimmunization of A-negative sheep with the blood of A-positive sheep. The B system which has its serologic and, presumably, genetic homology in the B system of cattle is, like B of cattle, very complex. So far, 52 B phenogroups have been identified in sheep, as compared to at least 164 in cattle, and doubtless many more will be discovered. The C system which has its serologic and, presumably, genetic homology in the C system of cattle is presently known to comprise three phenogroups: C, C_x, and no-C. With the development of new diagnostic reagents, it is possible that the C system of sheep might be expanded into a system which more closely parallels the complex C system of cattle. The D system, which is the only system studied by means of an agglutination rather than a hemolytic test, has two phenogroups, D and no-D. Three phenogroups (M, M_x, and no-M) are recognized in the M system; this system may be homologous to the S-U system of cattle. The X-Z system, with three phenotypes X, XZ, and Z, is, so far, much like the "two-allele" F-V system of cattle. Tabular data are presented, and other features of these six systems are discussed.

RASMUSSEN, INGE E. Persistence of Mutants in Laboratory Populations of *Drosophila melanogaster*. *Istituto di Genetica, Università di Pavia, Pavia, Italy.*

In a search for mutants of *Drosophila melanogaster* with heterotic effect, several autosomal recessives were tested in competition with the wild-type allele in experimental populations. Some mutants reached a stable frequency, probably due to the superiority of the heterozygote. So did *e*, *se*, *cd*, already known from the literature as having an advantage in the heterozygous condition, with equilibrium frequencies of .16, .25, .58, respectively. In addition *shv*, *bw*, *rsd* reached equilibrium frequencies of .54, .26, .32. The possibility of other explanations than overdominance cannot be ruled out for some of these mutants, but seems quite unlikely for others. Such overdominant loci deserve special attention because of their effect on population variance and as a suitable material for a more analytical approach to the general problems of heterosis.

RATTENBURY, JOHN A. Cytogeobotanical Studies in the New Zealand Flora. *Department of Botany, University of Auckland, Auckland, New Zealand.*

The New Zealand angiosperm flora is said to contain a number of foreign elements. Plants with affinities with these areas are thought to have reached New Zealand at different times and to have remained subsequently to form a mixed flora in New Zealand. Most important of these affinities are an Antarctic element, with extensions to South America and Tasmania, and a Malayan element, extending northward through Melanesia.

Another hypothesis suggests that there has been a more or less continuous northward movement from an ancient temperate Antarctic flora into South America, Australasia and South Africa. Continuing northward from New Zealand some of these plants would eventually reach south-east Asia.

To test in part these alternative theories, viz.: whether there is a Malayan element in the New Zealand flora or a New Zealand element in the Malayan flora, a study of the incidence of polyploidy in plants belonging to the same genera in New Zealand and New Caledonia (which lies in the direct migration route between Malaya and New Zealand) is being undertaken.

Interpretation of such data is extremely difficult and conclusions may only safely be drawn on the basis of many chromosome counts where these point in a single direction. In the case of *Xeronema* and *Cordyline*, the diploids are in New Zealand and the polyploids lie to the north. In *Anthropodium*, diploids are present in New Zealand and New Caledonia while a tetraploid is present in New Zealand as well. Some forty to fifty additional species pairs will be examined shortly as a result of a trip to New Caledonia in February. These results will be presented in the paper.

RAVIN, A. W. Specificity in the Efficiency of Response by *Pneumococcus* to Different Transforming Agents. *Department of Biology, University of Rochester, Rochester, N. Y., U.S.A.*

A recipient strain of *Pneumococcus* treated briefly with deoxyribonucleic acid from a donor strain differing from it by a number of inherited characteristics may be transformed for any or all of these. However, not all the markers in a given transforming DNA preparation are acquired by the host population with the same efficiency. In recent experiments, a multiplying host population, deficient for capsule synthesis and sensitive to streptomycin and erythromycin, was treated for 15 min. (approximately one-half the generation time) with DNA extracted from a previously transformed clone of this strain, one that was encapsulated and resistant to 1 μ/ml. of erythromycin and to >100 μ/ml. of streptomycin. The treated population was then rapidly diluted in DNAase-containing medium and samples removed to inoculate parallel cultures such that an inoculum rarely contained more than one bacterium capable of giving rise to progeny transformed for a given characteristic. Each culture was later plated to determine the number of transformants of each type. The fraction of parallel cultures containing transformants varied according to the marker. The marker affecting capsule synthesis appeared in the greatest number of parallel cultures, the marker controlling resistance to erythromycin was found almost as frequently, but the marker controlling resistance to streptomycin was found considerably less frequently. These differences were independent of the total transformation frequency, which varied with the degree of competence of the host population or with the length of time of exposure to transforming DNA in several otherwise similar experiments. These differences cannot be explained by any genetic heterogeneity in the donor population, for plate counts made on selective media just before the transforming DNA was extracted showed that every donor bacterium was encapsulated, streptomycin-resistant, and erythromycin-resistant. On the other hand, the extent of these differences is a function of the specific markers employed, for there are several different markers affecting various levels of antibiotic resistance and varying extents of capsule synthesis. A group of three markers for these characters can be selected, however, such that the observed differences in "uptake" are regularly large and significant.

The differences in "uptake" for the capsular, erythromycin and streptomycin markers are not due to differences in the times required for phenotypic expression of each of the markers. The time at which the parallel cultures are examined for transformants is well beyond the time required for maximal expression of each of the markers. These results will be discussed.

(These studies were supported by Research Grant E-727 awarded by the National Institute of Infectious and Allergic Diseases.)

RAY, CHARLES, JR. Tetraploidy in *Tetrahymena pyriformis*. *Emory University, Georgia, U.S.A.*

Three clones of *Tetrahymena pyriformis*, classified as mating types I, II, and III of variety 6, have been maintained in non-bacterial media since 1953. In 1956 we determined the chromosome number to be five pairs for each of the three clones. A re-study made in 1957 revealed that the micronucleus of one of the clones had become tetraploid. This spontaneous ploidy during asexual reproduction of the clone possibly came about through failure of the anaphase separation of duplicated chromosomes in the micronucleus. In the affected culture the tetraploid animals nearly replaced the diploid ones during the time between the origin of the ploidy and our discovery of it. No difference in body size or in macronuclear size of the tetraploids versus the diploids was detected. The micronuclei of the tetraploids were larger than those of the diploids. We noted in the tetraploid clone a marked reduction in the refractory period (from six to two hours) and pair formation within the clone (i.e., selfing) following suspension of the animals in distilled water. We had observed neither behavior in this clone before ploidy.

Using tetraploidy as a marker for the clone, we examined conjugants following a mixture of complementary mating types and found that the pairs formed first were between individuals of complementary mating types, while pairs formed about five hours later were mostly between individuals of the tetraploid clone (selfing). Using chromosome numbers of synkarya as evidence, we found that some synkarya had resulted from the fusion of sister pronuclei (i.e., cytogamy).

If conjugating pairs isolated for genetic analysis include instances of such deviations from a reciprocal exchange of pronuclei of complementary mating types, an interpretation of the observed ratios might be difficult without an estimate of the extent of these different behaviors.

RAY, DAVID T. Sensitivity of Different Stages of the Eggs of *Mormoniella* to X-Rays. *Howard University, Washington, D.C., U.S.A.*

Female *Mormoniella* wasps were irradiated with varied dosages (500 r–1,000 r–1,500 r–2,000 r–2,500 r). They were placed with host pupae of the fly *Sarcophaga bullata* and transferred to new host pupae at frequent intervals. Eggs (laid at successive times after irradiation) had been irradiated at different meiotic stages. Eggs laid within 6 hours after irradiation have been X-rayed during the first meiotic metaphase. Egg counts were made using the damp chamber technique. Because of the parasitic nature of *Mormoniella* an accurate count of eggs can only be made by removing them from their host. The counted eggs must be placed in another host for further development. The new host pupae were first stung by sterile female wasps. A small aperture was made in the stung pupae and the eggs inserted within. The pupae were then placed in open mouth vials and suspended by metal racks over a saturated solution of NaCl in large covered jars, to ensure the correct humidity and discourage mold. The eggs were observed for hatching and development without being disturbed. Results indicate that while the number of eggs hatching decreased as expected with increase in X-ray treatment, the number of offspring from eggs laid during the first 6 hours decreased drastically. Only 8% of these eggs from females given 1,000 r developed as against 20% of eggs laid after 24 hours. No eggs developed from wasps given dosages above 1,500 r in this group. Reduction in the number of offspring from eggs laid in successive hours was not nearly as drastic. This seems to indicate a higher sensitivity of the first meiotic metaphase to irradiation, with the sensitivity decreasing in the earlier meiotic and premeiotic stages. (This work was supported under National Science Foundation Grant NSF G–2587.)

RAY, DAVID T. *See* WHITING, P. W.

REED, T. EDWARD. Methods and Problems in Estimating Relative Fitness in Man: Examples from a Study of Huntington's Chorea. *Department of Human Genetics, University of Michigan, Ann Arbor, Mich., U.S.A.*

Relative fitness (*W*) of individuals with a specific genetic trait has customarily been defined, and measured, as the ratio of the mean number of children born to the trait-bearers to the corresponding mean of the normal sibs of the trait-bearers. It is assumed, but is rarely demonstrated, that the normal sibs give a valid estimate of the fertility of the general population. This study reports an example of a significant difference in fertility between normal sibs and the general population and makes suggestions for estimating relative fitness.

An extensive survey of Huntington's chorea (H.C.) in Michigan (U.S.A.) provided an opportunity to estimate relative fitness for a dominant trait whose *W* is near unity. Using individuals who had completed their reproduction, it was found that the relative fitness of heterozygotes for the gene for H.C. was 1.03 ± 0.11 if the conventional sib comparison was made. Comparison with appropriate age-specific fertility data of the U.S. Census, however, revealed that these normal sibs were significantly less fertile than the females of Michigan. Comparing heterozygotes with these normal Michigan females gives a W of 0.79 ± 0.12.

Because the ratio of mean numbers of children ever born does not necessarily express the relative rates of growth of the two classes being compared, a more precise definition of relative fitness is offered. This makes use of the parental age distribution as well as the mean number of livebirths ever born per newborn individual.

Other aspects of estimating relative fitness are also considered. It is strongly urged that, when possible, W be estimated directly as the ratio of (*a*) mean number of children ever born to trait-bearers to (*b*) the corresponding mean, comparable in date and age range, for the general population.

REEVE, E. C. R. The Induction, by X-Rays, of Mutations Affecting Quantitative Characters in *Drosophila melanogaster. Institute of Animal Genetics, University of Edinburgh, Edinburgh, Scotland.*

Our ignorance of the rate at which mutations affecting different quantitative characters arise spontaneously or in response to mutagenic agencies forms one of the biggest gaps in our knowledge of population genetics, and the present paper will describe some work in this field, using a method which enables the mutational variance of several characters to be measured at the same time.

By a suitable crossing scheme with *Drosophila melanogaster* it is possible to make standard irradiated third chromosomes homozygous in a genetic background identical with the inbred line providing the third chromosomes. A number of such strains have been produced, using an X-ray dosage of 4,000 r, and both the homozygous strains and intercrosses between them have been raised under standard conditions.

Wing and thorax length and the numbers of sternite and sternopleural hairs were estimated on these strains and crosses, and also on control strains obtained by the same mating scheme without irradiation. Strains in which third chromosomes from a wild stock were made homozygous in the same inbred genetic background were also studied, to give a standard against which the radiation-induced genetic variance could be compared.

The results of these experiments will be discussed, but one point of interest which emerged may be noted here. The environmental variance in body size among individuals of the same genotype was, on the average, greater for the homozygous strains than for their intercrosses. This suggests that the third-chromosome heterozygosity induced by 4,000 r of X-rays was sufficient to increase the environmental stability of the intercrosses over that of the homozygotes.

REMPEL, WILLIAM E. *See* SUMPTION, LAVON J.

RETHORE, MARIE ODILE. *See* LEJEUNE, JERÔME.

RICHTER, ALAN A. Recombination Analysis of Mating Type in *Escherichia coli* K12. *Department of Genetics, University of Wisconsin, Madison, Wis., U.S.A.*

An F– strain, $♀_3$, was previously reported to be convertible, upon exposure to F+ cells, to the Hfr$_3$ mating type, here termed $♂_3$, which displays high frequency of segregation for markers in region 3 (Th M Xyl S). It was shown that the $♂_3$ phenotype depends upon the presence of the transmissible agent F and a gene Hfr$_3^+$ which does not recombine with a marker *Mal*$_5$. From a cross of $♂_2$ (Hayes Hfr strain) × $♀_3$, four mating genotypes are recovered, the two parental types, standard F– (convertible to standard F+), and a type referred to as compound male. The same cross demonstrates that the ability to yield infectious F agent does not recombine with the $♂_2$ quality. One may therefore postulate that the F agent of $♂_2$ resides at a locus Hfr$_2$, thereby determining the $♂_2$ phenotype. Hfr$_2$ is defined by its position in the following sequence: Gal Lac P L T Hfr$_2$ Hfr$_3$ Th M Xyl S. The compound male type has the following properties in common with $♂_2$. (1) In crosses with F–, it displays high frequency of segregation for markers in region 2 (T L P Lac Gal) and low frequency of segregation for markers outside region 2(Hfr$_2$ Mal$_5$ Th M Xyl S). (2) It is stable as shown by the fact that the vast majority of progeny from crosses × F– are F–. (3) The ♂ quality recombines with Mal$_5$. It is possible to distinguish the compound male from $♂_2$ by the fact that Hfr$_3$ segregates in crosses of compound male × F–. The new mating type therefore carries both the determinant of the $♂_2$ property (F present at Hfr$_2$) and the determinant of the $♀_3$ property (Hfr$_3^+$).

RICK, CHARLES M. Disturbed Segregation in Progenies of *Lycopersicon esculentum* × *L. chilense. University of California, Davis, Calif., U.S.A.*

Several F_1 hybrids were obtained between *Lycopersicon esculentum* homozygous for markers (a, c, d, l_1) on four chromosomes and a stock of *L. chilense* that possesses the respective dominant alleles. Meiosis, including pachytene pairing, appears normal, and about half the pollen is aborted. Since the F_1 hybrids exhibit the strict self-incompatibility of the *chilense* parent, F_2 progenies were obtainable only by intercrossing intercompatible hybrids. A first BC generation was obtained by using the recessive *esculentum* stock as female parent.

Recessive homozygotes are generally deficient in F_2 and in excess in BC. The degree of deviation from *esculentum* controls varies according to the gene, highly significant departures having been observed for d and l_1, and less marked discrepancies for a and c in both F_2 and BC. The deficiencies in F_2 are in accord with a shift toward *L. chilense* observed in distributions of quantitative species-differentiating characters. Significant heterogeneity exists between BC progenies for both a and l_1, but not for c and d. Differential survival is suspected to have caused this heterogeneity, since germination is variable and never exceeds 25%. A general but nonsignificant tendency was observed toward association between parental character combinations in F_2. A similar but less consistent trend appeared in BC. Segregations in several second BC families closely approached normal.

The opposing deviations of BC and F_2 discount imperfect penetrance and differential survival of gametes during maturation as the sole causes of the disturbed segregations. Differential pollen tube growth and/or zygotic elimination could be completely responsible, the latter being suggested by the greatly reduced seed fertility.

(Support for this work by grant No. G–3355 of the National Science Foundation is gratefully acknowledged.)

RIEGER, RIGOMAR, and ARND MICHAELIS. The Induction of Automutagenic Substances by Submersion of *Vicia faba* Seeds in Tap Water. *Institut für Kulturpflanzenforschung der Deutschen Akademie der Wissenschaften zu Berlin in Gatersleben, Kreis Aschersleben, Germany.*

Seeds of *Vicia faba* L. var. *minor* ($2n = 12$) were submerged in tap water and left to soak there for 12, 24, 48, 72 and 96 hours. After submersion and recovery for 48 to 144 hours in petri dishes, root tips were fixed at intervals of 24 hours. The presoaking of the seeds led to a remarkable increase of the spontaneous chromosomal aberration rate. Up to 65% of all cells in the root tip meristem showed fragments, chromatid translocations and triradials after 72 hours of presoaking and up to 12% of all chromosomes showed breaks or participated in chromatid reunions. Submersion for 72 hours called forth the maximal effect, and was not increased by presoaking for 96 hours. Submersion of seeds for 12 hours only caused a statistically significant increase of chromosomal aberrations in relation to the controls. The maximum of aberrations was found after a recovery period of 120 hours; afterwards the aberration rate dropped and the aberration spectrum changed because of cell selection. All reunions occurred on chromatidal basis apart from the triradials. The highest number of breaks per cell was 10. The distribution of breaks between the small m- and the large SAT-chromosomes was not random (theoretical expectation 5:2); more breaks appeared in the small chromosomes (actual relation m:SAT = 5:1.1). The breaks were localized in a few probably heterochromatic regions.

To exclude the possibility that the effect of submersion was really caused by bacterial products, parallel experiments were done with a N_2-atmosphere. These experiments showed that the increase in aberration rate in both cases was caused by metabolic changes induced by anaerobiosis. Probably the changed metabolic conditions led to the formation or accumulation of automutagenic substances.

The leaves of the young seedlings growing from seeds submerged for 48 to 96 hours were characterized by growth abnormalities and variegation caused by chromosome mutations.

Our experiments show that anaerobiosis under special circumstances is to be viewed as one of those factors which lead to spontaneous mutations because one must reckon with periods of partial anaerobiosis under natural conditions also. The effect of anaerobiosis found in *Vicia* according to preliminary observations is not reproducible in barley probably because of other reserve substances in the barley seeds not found in *Vicia.*

RILEY, HERBERT PARKES. Karyotypes of Some South African Species of Plants. *University of Kentucky, Lexington, Ky., U.S.A.*

Chromosome counts were made from the root tips of germinated seeds of 55 South African species of plants from 47 genera and 21 families. In an attempt to bring out secondary constrictions and heterochromatic regions, various chemical compounds were used as pretreatments or as additions to the fixative, including bromonaphthalene, aesculin, chloral hydrate, 8-oxy-quinoline, coumarin and paradichlorbenzene. Chromosome counts were confirmed for 10 species previously studied by various investigators. Chromosome numbers and karyotypes were obtained from the following species which belong to genera in which chromosomes have apparently not been studied previously: *Clematopsis stanleyi* (Family Ranunculaceae), *Pollichia campestris* (Caryophyllaceae), *Acrodon bellidiflorus* (Ficoidaceae), *Adansonia digitata* (Bombacaceae), *Triaspis nelsonii* (Malpighiaceae), *Schotia brachypetala* (Caesalpiniaceae), *Baphia obovata* and *Bolusanthus speciosus* (Papilionaceae), *Berchemia speciosus* (Rhamnaceae), *Melianthus comosus* and *M. minor* (Melianthaceae), *Adenium multiflorum* (Apocynaceae), *Hoodia Burkei* and *Pachycarpus schinzianus* (Asclepiadaceae), *Nautochilus labiatus* (Labiatae), and *Aristea thyrsiflora* and *Dietes prolongata* (Iridaceae). Chromosome numbers and karyotypes were determined for the following species in which chromosomes have apparently not been previously studied, although chromosome counts are on record for other species of the respective genera: *Glottiphyllum muirii, Delosperma mahonii, D. sutherlandii*, and *Dorotheanthus gramineus* (Ficoidaceae), *Momordica clematidea* (Cucurbitaceae), *Terminalia phanerophilia* (Combretaceae), *Cassia granitica* var. *abbreviata* (Caesalpiniaceae), *Dichrostachys nyassana* and *Acacia pallens* (Mimosaceae), *Erythrina lysistemon* (Papilionaceae), *Cissus lanigerus* (Ampelidaceae), *Carissa grandiflora* (Apocynaceae), *Aster capensis, Felicia rotundifolia* and *Vernonia glabra* (Compositae), *Ipomoea albivenia* (Convolvulaceae), *Coleus barbatus, C. pentheri, Plectranthus myrianthus, Pycnostachys reticulata* and *P. urticifolia* (Labiatae), *Chlorophytum longipedunculatum, Eucomis regia*, and *Gloriosa virescens* (Liliaceae), and *Babiana bainesii, Moraea polystachya, Watsonia ardernei* and *W. fourcadei* (Iridaceae). Secondary constrictions were observed in the chromosomes of many of the species.

Riley, Ralph. Chromosome Pairing and Haploids in Wheat. *Plant Breeding Institute, Cambridge, England.*

Four kinds of haploid have been obtained in *Triticum vulgare* var. Holdfast ($6x = 42$) from lines involved in making additions and substitutions of single pairs of rye chromosomes. (1) Euhaploids with 21 chromosomes had the complete haploid chromosome set of wheat. (2) Two types of 22-chromosome addition haploid had the haploid complement of wheat plus one rye chromosome. (3) Three types of 20-chromosome nulli-haploid had the haploid set of wheat chromosomes minus one. (4) One 21-chromosome substitution haploid had 20 chromosomes of the haploid set of wheat plus one rye chromosome. At first metaphase of meiosis in euhaploids, in the addition haploids, and in one of the nulli-haploids, there were mean bivalent frequencies of 1.0 to 1.7 per cell, and there was little difference between the three classes. Nulli-haploids of the second type, and the substitution haploid with the same 20 wheat chromosomes, had fewer bivalents than euhaploids (mean 0.7 to 0.9 per cell), suggesting that the missing chromosome often participated in bivalent formation in euhaploids. However, in the third nulli-haploid there was a mean of 4.2 bivalents and 0.8 trivalents per cell. Cells with three trivalents were not uncommon and 29% of cells had five to seven bivalents, in contrast to the other haploids examined in which trivalents were very rare and not more than four bivalents per cell were formed. Further, in this nulli-haploid 20% of the total bivalents were rings, whereas no more than 4% were rings in the other haploids. It seems, therefore, that the chromosome deficient in this nulli-haploid carries a gene which reduces pairing, so restricting association between homologous chromosomes. Such a gene would have selective value in hexaploid wheat for the effect which cytologically diploid behaviour would have on fertility and genetic stability.

The evolutionary significance of this situation and its potential value in wheat breeding, especially in the introduction of alien genes, will be considered, reference being made to the behaviour of nullisomics and alien chromosome substitutions.

RIPPON, JOHN W. and GEORGE H. SCHERR. Induced Dimorphism in Pathogenic Fungi. *Department of Microbiology, College of Medicine, University of Illinois, Chicago, Ill., U.S.A.*

Based on the concept that pathogenicity among the deep and superficial mycoses is, to a major degree, a direct function or limitation of the capacity of the organism to grow in a yeast phase, studies were undertaken in which transformation of mycelial (M) to yeast (Y) phase for the superficial dermatophytes has been attempted along with the transformation of M to Y phase growth in *Histoplasma capsulatum* at temperatures less than 37°C. Utilizing the gradient plate technique, cultures of *Microsporum audouini*, *Trichophyton rubrum*, and *Cladosporium mansoni* were subjected to increasing concentrations of cysteine at temperatures of 25°, 30°, and 37°C. *M. audouini* and more particularly *T. rubrum* growing at 37° in the areas of higher cysteine concentration appeared yeast-like. *C. mansoni*, which normally has some yeast-like character when grown at room temperature, appeared nearly 100% as a budding yeast. Combinations of temperature and cysteine radically altered pigment production as well as the morphology of the dermatophytes. Ether-acetone extracts of *Saccharomyces cerevisiae* were tested for their ability to induce M to Y transformation of *H. capsulatum* at temperatures other than 37°C. The results indicated activity of some fractions to convert mycelium to yeast phase growth at 25°C. The ramifications of these data with reference to the pathogenesis of these diseases will be discussed.

(This report is part of a study supported by Grant No. E–1651 from the U.S. Department of Health, Education, and Welfare, National Institutes of Health.)

RIS, HANS. Fine Structure of the Nucleus during Spermiogenesis. *Department of Zoology, University of Wisconsin, Madison, Wis., U.S.A.*

The study of chromosomes and interphase nuclei with the electron microscope has suggested that chromosomes consist of microfibrils. Fibrils about 100 Å thick seem to be a universal component of chromosomes and the smallest structural unit undisputably resolved in somatic nuclei. Generally these fibrils are associated in pairs, forming a next higher unit about 200 Å thick and in prophase chromosomes these are again organized by two's into units about 500 Å thick. In addition to these fibrils a complex larger structure has been described in meiotic chromosomes of animals, the so-called core or central structure (Moses, Fawcett). We have been interested especially in these two problems: (1) what is the relation of these fibrils to the known chemical constituents of chromosomes (DNA, RNA, basic proteins, residual proteins); (2) what is the constant and persisting structure in chromosomes, the material of genetic continuity in contrast to structures which appear only under specific conditions? In a study of the nucleus during spermiogenesis one would expect the chromosomal material to be reduced to the bare essentials for genetic continuity. Chemical studies show that the composition of the nucleus undergoes profound changes during spermiogenesis. What happens to the chromosome fibrils during this process? Electron micrographs will be shown illustrating the nuclear changes during spermiogenesis of several insects (grasshoppers, roaches), cephalopods (sepia, octopus), and vertebrates (minnow, rooster, rat). In all these we found that the 100 Å fibrils seen in early spermatid nuclei split up into fibrils, about 40 Å thick, which then fuse into larger complexes in which the individual fibrils are no longer visible. Finally the entire sperm nucleus becomes uniformly dense and homogeneous. The specific way in which the 40 Å fibrils aggregate, however, and the orientation of the fibrils in the sperm nucleus vary greatly. In some species the fibrils line up side by side into complexely folded sheets, in others they fuse into straight or much twisted bundles which gradually combine into larger complexes. X-ray diffraction studies on sperm nuclei have shown that DNA molecules are oriented parallel to the long axis of the sperm (Wilkins). During spermiogenesis the microfibrils straighten out and line up in the same way. This suggests that the DNA is arranged parallel to the long axis of the chromosomal microfibrils.

RIZET, GEORGES. Un nouvel Ascomycète intéressant pour les généticiens, *Ascobolus immersus. Faculté des Sciences de Paris, Laboratoire de Génétique, Paris, France.*

Le genre *Ascobolus* a déjà fait l'objet de diverses études génétiques et plusieurs espèces, *A. immersus*, *A. stercorarius*, ont permis d'obtenir quelques mutants dont les caractères sont visibles sur les ascospores. Celles-ci sont projetées à maturité et peuvent être reçues par groupe de huit sur un milieu transparent où elles sont facilement observables. On peut ainsi, très rapidement, observer des milliers d'asques. *A. immersus*, de plus, possède des ascospores énormes dont l'isolement est d'une grande facilité.

Plus de quatre vingt mutants, apparus spontanément et intéressant les caractéres de l'ascospore ont été isolés. Il s'agit le plus souvent d'ascospores peu pigmentées ou totalement incolores, mais aussi d'ascospores à membrane rugueuse ou enfin d'ascospores sur lesquelles le pigment se dépose sous forme de gouttelettes plus ou moins grosses et plus ou moins nombreuses. Nous avons donc pu observer des ségrégations extraordinairement variées, visibles immédiatement.

Plus de la moitié des gènes ainsi définis appartiennent au même groupe de linkage. Tous les degrés de linkage ont pu être observés et il devient très facile de faire l'analyse du crossing-over et des variations de sa fréquence. De très nombreuses anomalies de ségrégation décrites sous le vocable de conversion ont été vues: leur fréquence est variable selon les gènes envisagés et selon le milieu. Près des deux tiers des gènes se répartissent en une dizaine de séries d'allèles; soit d'homo-allèles avec fréquence de réversion pratiquement nulle, soit d'hétéroallèles avec réversions plus nombreuses et quantitativement mesurables par l'analyse directe des tétrades.

Ce matériel se révèle donc bien adapté à l'étude de problèmes variés.

RIZKI, M. T. M. Factors Influencing Haemocyte Transformation in Normal and Tumorous Larvae of *Drosophila melanogaster. Reed College, Portland, Oregon, U.S.A.*

It was previously demonstrated that there are two main classes of blood cells in larvae of *Drosophila melanogaster* (Ore-R strain), crystal cells and plasmatocytes. The plasmatocytes are spherical cells which at the time of formation of the white puparium develop filamentous cytoplasmic extensions. This morphological transformation continues during early pupation until extremely flattened cells are formed. These flattened cells are the lamellocyte variants. In the tumorous strains, tu^w and mt^A, this mass transformation of plasmatocytes to lamellocytes occurs at the second molt and in the early third instar. The lamellocyte aggregates form tumorous masses which later become melanized. This precocious transformation of blood cells in these tumorous strains suggested an upset in the normal pattern of metamorphosis of the haemocytes.

The influence of humoral centers such as the ring gland and brain on metamorphosis has been established in *Drosophila* and other insects by several authors. A causal analysis of transformation of the larval blood cells of *D. melanogaster* has been attempted by a series of ligature experiments. Early third instar larvae (64–66 hours at 24°C) of the Ore-R strain have been ligatured so that the brain and ring gland humoral centers (BRH) are excluded from the posterior part of the body. Control larvae were ligatured slightly anterior to those of the experimental group in such a way that the BRH was included in the posterior part of the body. After 24 hours blood samples were examined from the posterior region of the ligatured larvae. Exclusion of the influence of BRH results in mass transformation of plasmatocytes to lamellocytes, whereas this phenomenon is not noted when the plasmatocytes are exposed to the influence of BRH. Humoral factors play a significant role in the transformation of the plasmatocytes, and these experiments support the hypothesis that the physiological syndrome controlled by the tumor genes includes an upset of the humoral mechanism. (Work supported by National Science Grant G–3381 and Public Health Service Grant RG–5285.)

ROBERTS, J. A. FRASER. Some Further Observations on Associations between Blood Groups and Disease. *Clinical Genetics Research Unit, Institute of Child Health, Hospital for Sick Children, London, England.*

A number of mental hospitals collaborated in a survey organized by the Royal Medico-Psychological Association, grouping newly admitted patients during the calendar year 1957. The total number is about 20,000. The forms are now being coded and the cards punched. It is hoped to present a preliminary account of the results.

In collaboration with Professor Ian Aird and his Department data have been collected on three conditions. In 600 cases of cancer of the pancreas there was an excess of Blood Group A, significant at the 5% level. If confirmed, this will be another example of a positive result with a disease associated with the upper part of the gastro-intestinal tract. In 600 cases of cancer of the oesophagus a relative incidence in Group A of 1.1 as against 1 in Group O appeared. This would equally fit a negative result or the 1.2 so far found in cancer of the stomach. It illustrates the large numbers needed in this kind of investigation. But 400 cases of chromophobe adenoma of the pituitary do not show the excess of Group O which was found by Professor Mayr and his colleagues at Boston. It would be interesting to discuss possible reasons for different findings in different regions in this and other conditions.

ROBERTS, MARGARET R., CAROLYN F.-R. DISSOSWAY, and HAROLD H. PLOUGH. Evidence for Linear Order of Transducible Loci and Prophage Sites in *Salmonella typhimurium. Amherst College, Amherst, Mass., U.S.A.*

Although linkage of units within loci in *Salmonella typhimurium* has been shown by Demerec and his associates, there is no current explanation of differences in frequency of transduction from one locus to another. Yet the transductions for each locus are fairly constant with each strain at similar multiplicities.

We have been studying transduction on a triple auxotroph of strain 533 by phage derived from 549 cells, using new plating methods and a cleared indicator strain, TC. The 549 cells are now recognized to be doubly lysogenic for phages 549t and 549m. Using the loci Histidine (H^-), Tryptophane (T^-) and Leucine (L^-) on a sub-strain of 533, transduction frequencies were determined with phages from: (1) the original lysogenic strain, 549; (2) this same phage grown on 533 host cells. The transduction frequencies per 10^8 cells at approximately the same multiplicities are shown in the following experimental results: 549(549t) + 533 $H^-T^-L^-$ gave 27.6 H^+, 13.8 T^+, 2.6 L^+; 533(549t) + 533 $H^-T^-L^-$ gave 73.0 H^+, 217.3 T^+, 7.4 L^+.

These results may be explained by assuming an arrangement of loci in a constant linear order, with the frequency of transduction in inverse relation to the proximity of any locus to the transducing prophage site. Differences in frequency of lysogenization of the three types of transduced cells in each series are directly related if the principal prophage sites are transposed. Actually the prophage sites for phages 549t and 549m have apparently been reversed in 549 and 533 strands.

The following indicates the map order for the 549 and 533 series (prophage sites in parentheses): 549 (*549m*) H^+ T^+ (*549t*) L^+; 533 (*549t*) H^+ T^+ (*549m*) L^+. These arrangements appear to be the only ones which satisfy the requirements of our available data.

The order of gene loci in *Salmonella* is interpretable in much the same way as in chromosome maps for higher forms, with transductions, like crossing over, introducing new segments in inverse relation to the proximity of the genes to the prophage site.

ROBERTSON, FORBES W. Cell Size and Number in Relation to Heterosis and Size Variation in *Drosophila. Institute of Animal Genetics, University of Edinburgh, Edinburgh, Scotland.*

Wing area of *Drosophila* is highly correlated with the size of the fly. By estimating cell density in the wing membrane, variation of wing size due to different kinds of genetic and environmental cause has been found associated with characteristic changes in the cell size and number relations. Culture at different temperatures affects only cell size. By rearing larvae on chemically defined, aseptic media, equivalent reduction of size may be effected by altering the level of specific nutrients.

Different treatments lead to striking contrasts in cell size and number; frequently all the reduction in wing can be attributed to change in a single component.

Comparisons of variance between wild populations and genetically uniform crosses between inbred lines indicate substantial genetic variation of cell size, which can be divided into a major part which is uncorrelated and a smaller fraction which is correlated with wing size. The former presents an aspect of the regulation of wing size, since there is a strong negative correlation between cell size and number. Selection experiments suggest that such variation is largely additive in behaviour. Response to selection for large and small size depends, at least in the early stages, on change in cell number. But crosses between selected strains, between inbred lines and also between geographical races show heterosis or a positive deviation from intermediacy in wing and cell area. Wing and cell area deviate about equally on a log scale; so the heterosis is expressed via cell size.

Evidence from genetic and environmental variation suggests that the factors which influence cell size and number are partly independent in action and show a different genetic behaviour in terms of additive and non-additive effects. The data, which are relevant to discussion of intra-population heterosis, asymmetry in selection response, inbreeding decline and gene-environment interaction, also illustrate the advantages of going beyond a purely numerical description of a quantitative "character."

Robinson, H. F., C. C. Cockerham, and R. H. Moll. Genetic and Genotype-Environmental Interaction Variances in Maize. *North Carolina State College, Raleigh, N.C., U.S.A.*

The variation in quantitative characteristics as reflected in phenotypic expression is a function of genotype and the environment in which it is produced. Phenotypic expression, the basis on which the breeder makes his choice, varies not only with the genotype composition and environmental effects which may be operating independently but with identical genotypes responding differently in different environments. The magnitude of genotype-environmental interactions, relative to the genotypic variance, can be of major concern to the breeder where the soundness of decisions on procedures to follow relates to the usable genetic variances.

The study reported here represents an attempt to obtain measures of genotype-environmental interaction variances that may be contributing to "biases" in estimates of genetic variances in maize populations. A series of half-sib families were produced for testing over a variety of locations and series of years. Five locations are used to represent the population of environmental effects that may be contributing to genotypic differences encountered at different places within a region of adaptation. The genotype-environmental interactions are measured in terms of estimated interaction variances of genotypes × years, genotypes × locations and genotypes × locations × years. Groupings of locations over the region of locations for which inferences are to be made enables an examination of the contributions of sub-region environmental fluctuations to genotype-environmental interactions. The findings in this study are compared with estimates of genetic and genotype environmental interaction variances available from other studies with maize.

Robinson, H. F. *See* Matzinger, D. F.

ROBSON, E. B. *See* HARRIS, H.

ROBSON, H. N. *See* BENNETT, J. H.

ROLLINS, W. C., and K. A. WAGNON. Genotype Environment Interaction in a Beef Cattle Herd. *University of California, Davis, Calif., U.S.A.*

A genetic analysis has been made of 335 long yearling heifer weights collected in two experimental range beef cattle herds, A and B, of similar breeding that were managed alike except that in herd A the heifers were supplemented to promote continuous growth during the fall and winter (post weaning) when the range was nutritionally deficient, while the heifers in herd B were not supplemented and usually lost weight during the period in question. Both groups made rapid gains during the subsequent period of good pasture. The heifers were long yearlings (about 20 months of age) at the end of the spring pasture season.

Heritability of weaning weight (weaning was at eight months of age) was estimated to be .36 for herd A and .42 for herd B. Heritability of long yearling weight was estimated to be .42 for herd A and —.23 for herd B. For gain from weaning to long yearling age, heritability was estimated to be .25 for herd A and —.04 for herd B. A genetic correlation of .74 and an environmental correlation of .62 was found between weaning weight and long yearling weight in herd A, while for herd B these were zero and unity, respectively.

Since in paternal half-sib estimates of heritability and genetic correlation dominance effects occur statistically in the term for random environmental effects, it is felt that these estimates considered jointly suggest a greater importance for heterozygosity and a lesser importance of additively genetic effects under B herd than under A herd conditions.

ROMASHOV, D. D. *See* PROKOFIEVA-BELGOVSKAYA, ALEXANDRA.

ROPER, J. A. Genetic Analysis of Cytoplasmically Determined Variation in *Aspergillus nidulans. Department of Genetics, University of Glasgow, Glasgow, Scotland.*

Strains of *Aspergillus nidulans* carrying nutritional markers and also resistant (single gene determined) to acriflavine undergo irreversible changes after serial subculture on medium with acriflavine. Controls without acriflavine are unchanged. Three such modified strains have so far been studied. They bear few or no conidia and are described as "mycelial." They are stable on repeated subculture, by hyphae or conidia, on any medium so far tested, with or without acriflavine. The mycelial condition can be transmitted to other genotypes (with or without a mutant allele for acriflavine resistance) by heterokaryosis. From balanced heterokaryons between strains A mycelial and B non-mycelial (where A and B represent differently marked nuclei) one recovers the types A mycelial, B non-mycelial and B mycelial but never the type A non-mycelial. Nucleo-cytoplasmic interactions are pronounced and each mycelial cytoplasm gives a wide range of phenotypes in combination with different genotypes.

The three original mycelial types have been shown to be cytoplasmically different by combining each cytoplasm with a common genotype; the three strains so obtained were morphologically quite distinct. Heterokaryons formed between pairs of strains, each with a different mutant cytoplasm, did not restore the non-mycelial phenotype.

Balanced heterokaryons (and heterozygous diploids derived from them) between a mycelial and a non-mycelial type are almost normal in phenotype, suggesting that the mycelial condition is little expressed in a prototroph. However, mitotic recombination in such diploids gives types of which a proportion are mycelial. At mitotic recombination the determination of a mycelial versus a non-mycelial phenotype appears to be correlated with the particular genotype produced by crossing over or haploidization.

Crosses between a mycelial and a non-mycelial give both mycelial and non-mycelial types. Preliminary results suggest that segregation of "mycelial" at meiosis is irregular.

ROSS, JAMES G., CLIFFORD J. FRANZKE, and MARY E. SANDERS. The Immediate Induction of Homozygous Diploid Mutants in Sorghum. *Agronomy Department, South Dakota State College, Brookings, S.D., U.S.A.*

True-breeding, diploid, mutant plants arise from colchicine treatment of sorghum seedlings of lines Experimental 1 and Experimental 3. It was proposed that in Experimental 3 the mutant condition might arise through concentrations of chromatin from ancestors from which this line was derived, and that the true-breeding diploid condition might arise by a somatic reductional division of the chromosomes with subsequent restoration to the diploid number.

The first part of the hypothesis was tested by observing meiotic pairing relationships in true-breeding mutants and in F_1 hybrids between mutants and their untreated full sibs. No irregularities were observed indicating no major relocation of chromatin in the mutants. Genetic analyses of F_2 populations from these crosses provided evidence that genotypic changes resulted from point mutations. Study of an F_3 population from a cross between one mutant and its untreated full sib gave an estimate of at least 13 changed genes. Induction of a lineal series of diploid mutants (all showing normal meiosis) by colchicine treatment of each successive new mutant furnished additional evidence for the mutagenic action of colchicine.

To test the second part of this hypothesis, seedlings with chromosome markers (recessive genes and reciprocal translocations) in the heterozygous condition were treated with colchicine. The hypothesis is supported by the appearance of homozygous shoots after colchicine treatment of F_1 flax plants heterozygous for known genes. Some sorghum lines fail to produce obvious true-breeding diploid mutants following colchicine treatment, and lines known to give mutants do not always do so. Failures to find homozygous shoots after treatment of heterozygous materials may also be due to either an unfavorable internal (genotype) or external environment. The effects of water availability, nutrition, light and temperature during treatment are being studied. The original mutants arose in an unshaded greenhouse; recent results show that diploid mutants can also be obtained by colchicine treatment under infrared light.

ROSSI, J. *See* STROUN, J. H., *et al.*

ROTHENBUHLER, WALTER C. Genetics of a Behavior Difference in Honey Bees. *Department of Zoology and Entomology, Iowa State College, Ames, Iowa, U.S.A.*

Honey bees (*Apis mellifera* L.), living in highly organized social units, show an extremely rich display of behavior. Behavior patterns are evident in the gathering of nectar, pollen, and water, the sharing of food, the building of comb, the care of the brood and the broodnest, the casting of swarms, the use of propolis in the hive, the defence of the colony, and the transmission of information about food sources by the well-known dances. Furthermore, different strains and races show characteristic differences in some of these behavior patterns. Since artificial insemination makes control of matings possible, genetics of honey-bee behavior now can be studied readily.

One of the mechanisms by which honey bees resist the larval disease American foulbrood (causative organism: *Bacillus larvae* White) has been observed to be behavioristic. The present study revealed that one selected, inbred, resistant line of bees removed all of the diseased brood from the test combs prior to the sixteenth day following inoculation on the first day of larval life. Peak removal occurred usually on the eighth to tenth days. The selected, inbred, susceptible line allowed most of the diseased brood to remain in the test combs throughout the experiments which ended on the sixteenth day.

Reciprocal crosses of these two lines produced an F_1 generation which allowed diseased larvae to remain in the broodnest in the same way as the susceptible line. Hence, resistant or hygienic behavior appears to be due to recessive heredity. Experiments, now in progress, with back-crosses of the F_1 generation are expected to yield information on the number of genetic elements involved in this difference in behavior. (This investigation was supported in part by a research grant E599(C7) from the National Institute of Allergy and Infectious Diseases of the National Institutes of Health, Public Health Service.)

ROTT, N. N. *See* PROKOFIEVA-BELGOVSKAYA, ALEXANDRA.

ROWLANDS, D. G. *See* GRIFFITHS, D. J.

RUDKIN, G. T., and S. CORLETTE. Disproportionate Synthesis of DNA in Polytene Chromosomes. *Institute for Cancer Research, Philadelphia, Pennsylvania, U.S.A.*

Puff regions in polytene chromosomes of Diptera are thought to be regions of high gene activity. Breuer and Pavan's belief that deoxyribonucleic acid is accumulated in a puff region in *Rhynchosciara angelae* was confirmed by us in a preliminary report last year. In the present paper we shall present additional evidence pointing in the same direction. Quantitative estimates are made by measuring the absorption of monochromatic ultraviolet radiation in a chromosome region, and taking advantage of the absorption bands of nucleoproteins. The analysis of a chromosome into nucleic acid types and protein is carried out by measuring the change in absorption brought about by treating the chromosome with ribonuclease, deoxyribonuclease, and hot trichloroacetic acid, in that order. The results indicated that during the prepupal period studied: (1) the amount of DNA in puff regions at least quadrupled while that in non-puff regions doubled; (2) the DNA's deposited in the two puff regions studied may differ with respect to the ease with which they are extracted by the reagents used; (3) the protein (residue after extraction with hot TCA) at least doubled in the puff regions but increased by no more than 150% in non-puff regions; and, finally, (4) that RNAase did not extract measurable amounts of material (RNA) from either puff or non-puff regions in these fixed (45% acetic acid) chromosomes. It is concluded that the DNA content of a chromosome strand in a differentiated, somatic cell is not necessarily constant throughout development, but that changes may take place in active regions. It is not excluded that similar changes may occur in other instances in which no disproportionate change could be established within the variation of the data, e.g., in puffs in *Drosophila*.

RUDORF, WILHELM. Genetics of *Phaseolus aborigineus* Burkart. *Max-Planck-Institut für Züchtungsforschung, Köln-Vogelsang, Germany.*

Phaseolus aborigineus Burkart (Burkart and Brücher, Der Zuchter *23*:65–72), a line from Tucuman (our thanks go to Dr. Brücher for providing the seeds) which excels in resistance to the four known races of *Colletotrichum lindemuthianum*, is being used for breeding purposes. Genetics of the pronounced short-day reaction (neu^+) of the wild bean has been investigated, and it has been found, in short-day series, that in^+, the factor for indeterminate growth, segregates in a 3 : 1 relation without any disturbances. At the same time in^+ causes a clear-cut retardation in flowering, compared with *in*. In long-day series there was obtained a 9 : 3 : 4 relation for $in^+ \; neu^+$ (indeterminate short-day), $in^+ \; neu$ (indeterminate day-neutral) and [3 $in \; neu^+$ + 1 $in \; neu$] (determinate day-neutral). Control in F_3 proved that *in* is epistatic to neu^+.

If we consider as susceptible only plants which after infection with the four race groups of *Colletotrichum lindemuthianum* die like the susceptible parent and as resistant all those plants which either show no sign of infection (like the wild bean) or recover completely, then the genetics of resistance is: race groups α, γ, δ, 9 resistant : 7 susceptible; race group β, 3 resistant : 1 susceptible. Observations on segregation in quantitative characters, such as pod length and broadness as well as weight and size of seed, proved that the genetics of these characters follows the same line as in crosses of races or varieties of the species *Phaseolus vulgaris*.

In crosses with varieties of *Ph. vulgaris* fertility is complete and segregation quite normal. The genomes of *Ph. vulgaris* and *Ph. aborigineus* therefore seem to be homologous, and varieties of the cultivated garden-bean will have developed from the wild bean by different mutation steps.

RUDORF-LAURITZEN, M. The Trisomics of *Antirrhinum majus* L. *Max-Planck-Institut für Züchtungsforschung, Köln-Vogelsang, Germany.*

From crosses of tetraploid with diploid forms of *Antirrhinum majus* L. ($2n = 16$) $3n$ and $3n \pm 1$ or 2 plants have been obtained, which again were crossed with diploids.

Whereas $3n$ plants gave 114 good seeds out of 144 crosses, $3n \pm 1$ or 2 gave only 2 seeds of 68 crosses. The descendants consisted of 44.44% diploids, 42.86% trisomics, the rest being $2n + 1$ fragment, trisomics + 1 fragment, tetrasomics, tetrasomics + 1 fragment, pentasomics and triploids. The trisomics could be distinguished by their phenotype, which differed from normal diploids as well as from each other in many characteristics. Out of the possible 8 trisomics 6 had in 1932–3 been found spontaneously by Stubbe: Anaemica, Purpurea, Rotunda, Contracta, Candida and Fusca. New in appearance are the last two, Plicata and Lucens. The fertility of the trisomics, as determined by the amount of functional pollen, varies from 0% to about 60%. The difference can be high even between single flowers in the inflorescence of one plant. As concerns the number of germinating seeds, when the trisomics are used as mother, a more constant value is obtained. The descendants of trisomics × diploids give from 5–20% trisomics depending upon the particular trisomic concerned, the rest being diploids and aneuploids other than trisomics. If trisomics are used as father, only diploids are recovered.

The trisomics have been crossed with marker genes of the 8 existing linkage groups. From the segregation results after backcrossing until now 6 of the linkage groups could be associated with particular trisomics.

Cytological studies of these chromosomes will make it possible to co-ordinate the linkage groups with the morphologically destined chromosomes.

RUSSELL, ELIZABETH S., SELDON E. BERNSTEIN, and LOIS J. SMITH. Permanent Implantation and Continuing Function of Normal Blood-Forming Tissue in Genetically Anemic Hosts. *Roscoe B. Jackson Memorial Laboratory, Bar Harbor, Maine, U.S.A.*

Any double-dose combination of the deleterious genes of the W-series in the mouse (W, W^v, W^j) causes severe macrocytic anemia. Animals of the most severely affected genotype, WW, die shortly after birth. Haematopoietic cells from livers of 15 half-day normal embryos can become established in histocompatible anemic WW or WW^v hosts, and will continue to function autonomously according to their ww genotype. The hosts acquire a blood-picture indistinguishable from that of normal ww animals. The long-term effects of implantation of 8×10^6 isologous embryo-liver cells, following 200 r X-irradiation of the host, have been followed for 7 WW^v anemics and 10 normal littermates, with determinations of erythrocyte number and size made at 50-day intervals. From 510 to 720 days after treatment, the blood-picture of the anemics remains similar to that of ww animals of the same age. Attempts at implantation of homologous embryo liver cells in radiated anemic hosts have been unsuccessful with radiation doses of 200 r, 800 r, and 950 r. Prior radiation of hosts is not necessary for implantation if host and graft are completely histocompatible. Successful implantation of isologous ww embryonic haematopoietic tissue without radiation of the host has been attained as follows: 4 of 5 adult WW^v hosts; 9 of 14 juvenile (6–25 days old) WW^v hosts; 4 of 15 juvenile (7–13 days old) mice of the lethal WW genotype. The criterion of success was attainment and maintenance of erythrocyte number and size characteristic of normal ww mice. The erythrocyte level of implanted non-radiated anemics occasionally fluctuated for some time before becoming established at a permanent high level. Isologous ww cells implanted in non-radiated WW and WW^v animals compete successfully with the less active cells of the host and eventually completely dominate the blood-picture of the host.

RUSSELL, LIANE BRAUCH, and W. L. RUSSELL. Genetic Effects of Radiation in the Female Mouse. *Biology Division, Oak Ridge National Laboratory, Oak Ridge, Tenn., U.S.A.*

All stages of gametogenesis occur in the adult male mouse. In contrast, in the adult female, oogonia are not present, only the range from primary to secondary oocyte is represented, and, since meiotic metaphase I occurs only shortly before ovulation, the bulk of germ cells are primary oocytes, probably in dictyate stage. Studies of genetic effects of radiation in females therefore assume a unique position in that they deal exclusively with a gametogenic period whose products are not separately recoverable in the male. Furthermore, the dictyate state has not been observed in spermatocytes.

The major difficulties that had heretofore interfered with work on females—X-ray sterilization, and the danger of confusing genetic with maternal effects—have been analysed and resolved.

The living embryo/corpus luteum ratio accurately measures dominant lethal induction in females while litter size does not. The X-ray induction of 50% dominant lethals requires about 700 r in primary oocyte stages, but only 70 r at or near first meiotic metaphase. Proof of dominant lethality was established in both cases by demonstrations that death occurs after fertilization (most of it after 2-cell stage) and that about 60% of all eventual deaths are already represented by gross nuclear aberrations after the first cleavage.

The translocation frequency recovered from oocytes irradiated 1½–34½ days before ovulation is considerably lower than that recovered from irradiated sperm. Incomplete results from a pilot study on deleterious first generation effects indicate a shortening of life span in sons of irradiated females.

The specific locus mutation rate in oocytes exposed to 300 r continuous gamma-radiation at about 100 r per week is considerably lower than the rate in spermatogonia given 300 r acute X-rays.

RUSSELL, W. L., JEAN W. BANGHAM, and JOSEPHINE S. GOWER. Comparison between Mutations Induced in Spermatogonial and Postspermatogonial Stages in the Mouse. *Biology Division, Oak Ridge National Laboratory, Oak Ridge, Tenn., U.S.A.*

Male mice exposed to 300 r of X-rays were each mated to two females a week for six weeks following irradiation. The 33,874 offspring obtained were observed for mutations at seven specific loci. The mean mutation rate per locus obtained in this particular sampling of postspermatogonial stages is twice the rate found in earlier experiments with spermatogonia. However, the difference is not merely quantitative: the nature of the mutations recovered in the two experiments is quite different.

First, and most striking, in the experiments with spermatogonial stages no deficiencies involving both of the closely linked *d* and *se* loci (c.o. 0.16%) were found, although 22 induced mutations at the *d* locus and 3 at the *se* locus were observed. In contrast, the experiment with postspermatogonial stages, which, being less extensive, has yielded only 3 mutations at the *d* locus and 2 at the *se* locus, has, nevertheless, also given 5 mutations involving both *d* and *se* loci. Since at least 3 of these are transmitted to descendants, loss during gametogenesis does not appear to be the explanation for the absence of this type of deficiency in the mutations recovered from irradiated spermatogonia. Apparently these deficiencies are not commonly induced in spermatogonia.

Another contrast is the smaller variation in mutation rates among the seven loci in the experiment with postspermatogonial stages, there being only about a threefold difference between the lowest rate and the highest, whereas in the spermatogonial experiments the difference is more than thirtyfold. When this information is combined with the above, it appears that mutations recovered from irradiated spermatogonia are mostly point mutations with wide differences in mutation rate, whereas those recovered from irradiated postspermatogonial stages contain a large contribution from deficiencies and probably other aberrations which tend to equalize the rate at all loci.

RUSSELL, W. L. *See* RUSSELL, LIANE BRAUCH.

RYAN, FRANCIS J. Mutation as an Error in Gene Duplication. *Department of Zoology, Columbia University, New York, N.Y., U.S.A.*

In stationary phase populations of *Escherichia coli* mutants have been observed to appear. These have been shown to be due to genotypic changes occurring during that period. The possibility that these mutations occur during the cryptic growth of cells involved in a population turnover has been eliminated by several experiments including some utilizing penicillin and others depending on the development of adaptive enzymes.

Further investigations have been made on the question whether in these non-dividing bacteria there is the continued synthesis of polymers that might be concerned with gene mutation. Since direct chemical measurements might be difficult to interpret, an indirect approach involving attempts to prevent polymer synthesis was undertaken. Inhibitors and the starvation of double mutants were the means employed for this purpose.

Drugs such as chloramphenicol and growth factor analogues were presented to the non-dividing bacteria and it was determined whether the stationary phase mutations occurred in their presence. On the other hand, doubly marked strains, requiring amino acids, vitamins or nitrogen bases as well as being mutant at the locus under investigation, were starved for the substances mentioned. The rate of occurrence of stationary phase mutations under such conditions was compared with that occurring in properly supplemented cultures. Although in all cases the effect of these treatments on the synthesis of protein, RNA and DNA could only be inferred, the pattern with which the treatments prevented the occurrence of mutations allows the conclusion that these mutations require polymer synthesis and provides a clue as to what compounds are involved. The results are consistent with the hypothesis that gene duplication is necessary for most if not all of even these rare mutations which occur in the absence of cell division.

SACHER, GEORGE A. *See* GRAHN, DOUGLAS.

SACHS, LEO. The Possibility of Directed Immunogenetic Changes in the Cells of Mammalian Tumors. *Weizmann Institute of Science, Rehovoth, Israel.*

There are some malignant tumors that are unlike normal tissues in that they can give successful homotransplants: i.e., they grow progressively when grafted into animals with different genetic constitutions. The immunogenetic properties of such tumors in mice have been analysed by studies on: (1) the antigenic composition and antigenicity of the agglutinogens; (2) the types of antigens that elicit cytotoxins detectable by the addition of complement; (3) the degree of cytotoxic immunity evoked by tumor homografts; and (4) the chromosomes of the tumor cells. These studies have shown that although homotransplantable tumors may or may not have lost certain agglutinogens and cytotoxinogens detectable by the addition of complement, all those investigated have gained antigenicity. The ability to grow progressively in a foreign host is thus due not to the loss of antigenicity, but to a gain of resistance by the tumor cells to the iso-immune response. This gain of resistance seems to be due to an extra- or intracellular neutralisation by antigens of the tumor cells of the cytotoxic factors produced by the foreign host.

In experiments by others on the induction of immunological tolerance to tumor cells, it was shown that under certain conditions tumors can acquire the property of homotransplantability. The ability of these tumors to give successful homotransplants is also due to a gain of resistance to the immune response. There is evidence that this resistance may be acquired by cells directly as a result of growth under conditions of a weak immune response such as exist in partially tolerant animals. This therefore suggests the possibility of obtaining directed genetic changes in mammalian cells.

SAEZ, FRANCISCO ALBERTO. Chromosome Evolution in *Dichroplus*. *Instituto de Investigacion de Ciencias Biológicas, Montevideo, Uruguay.*

This paper is a general survey of the variation and evolution of chromosomes in some species of the genus *Dichroplus* (Orthoptera: Acrididae) found in Uruguay. A numerical series ranges from the supposed ancestral karyotype, $2n$ (♂)=23, to the extraordinary unexpected number of $2n$ (♂) = 8. *Dichroplus punctulatus*, *D. conspersus*, and *D. elongatus* have 11 pairs of acrocentric chromosomes and the sex chromosomes free. Variation was found in *D. bergi* with $2n$ (♂) = 22, 10 pairs of acrocentrics and 1 metacentric chromosome formed by fusion of the sex chromosome with an autosome (neo-Y, neo-X system) while the number of major chromosome arms is not reduced, remaining 23. *D. pratensis* (Bruner) has $2n$ (♂) = 18, 8 pairs of acrocentrics, 1 metacentric autosome and the sex chromosome free, but the number of chromosome arms is reduced to 19. Another form of *D. pratensis*? has $2n$ (♂) = 18 with 6 pairs of acrocentrics, 2 metacentric autosomes and 1 trivalent formed by fusion of the sex chromosome with a bivalent autosome (neo-Y, neo-X system), the number of chromosome arms remaining 23.

In Acridians, *D. silveira guidoi* (Liebermann), with $2n$ (♂) = 8, is extremely strange and unique: the karyotype is composed of 2 pairs of metacentric autosomes, 1 pair of acrocentric autosomes and a heterozygous acrocentric pair which is believed to represent the X-Y sex chromosomes. The whole number of chromosome arms is 12, meaning that 11 chromosomes had been "lost" of the original diploid set.

The above-mentioned species were found over all the Uruguayan territory except *D. silveira guidoi*, whose dispersion area was restricted to a small region in the northern part of the country. The striking mutation found in *D. Silveira guidoi* has been established in nature, having singular adaptive value, and is maintained in the population with few changes in the viability of the individuals. The probable mechanisms involved in the production of such exceptional evolutionary changes are discussed.

SAGER, RUTH. Non-chromosomal Inheritance in *Chlamydomonas. Department of Zoology, Columbia University, New York, N.Y., U.S.A.*

The discovery of a non-chromosomal determinant of streptomycin resistance in the sexual alga *Chlamydomonas reinhardi* was reported at the Genetics Congress in 1953; its uniparental transmission in crosses and its phenotypic stability were described. Subsequent studies of this material have centered on the question of the nature of this determinant and of the mutational process underlying its alteration. Evidence will be presented concerning the conditions under which mutated strains are recovered, and the implications of these findings will be discussed.

SAKAMOTO, S. *See* MATSUMURA, S., *et al.*

SAMPSON, D. R. Inheritance of Shades of Bronze and Pink Flower Colors in *Antirrhinum majus. Horticulture Division, Central Experimental Farm, Ottawa, Canada.*

Interaction effects of the genes *Inc*, *Pal* and *Rd* on intensity of anthocyanin pigmentation in flowers of *Antirrhinum majus* were studied in *eos eos* material. All possible combinations of the three genes were obtained in both *sulf sulf* (bronze) and *Sulf* (pink) plants. Flowers of *inc inc* or pal^{rec} pal^{rec} plants are acyanic. Both *Inc* and *Pal* are incompletely dominant and to the same extent. *Rd* is a fully dominant anthocyanin intensifier. *Inc inc*, *Pal* pal^{rec} and *rd rd* genotypes weaken the intensity of pigmentation equally. Interactions of the three genes result in four shades of both bronze and pink flowers.

SÁNCHEZ-MONGE, ENRIQUE. Rye Genome in "Terminillo" Wheat. *Centro de Mejora del Maiz del Instituto Nacional de Investigaciones Agronómicas, Madrid, Spain.*

The "Terminillo" wheat was obtained by the late Italian breeder Nazareno Strampelli from the back-cross (Rieti wheat × rye) × Rieti. Both forms, Terminillo and Rieti, can be classified botanically as *Triticum aestivum* L. var *erythrospermum* (Körn.) MSF., but they present some marked morphological differences. It can be reasonably assumed that such differences are due to the introgression of rye genes into the Rieti wheat. However, the possibility of such introgression is denied by several authors. Morphological and cytological proofs will be given to demonstrate that such introgression does occur.

SANDERS, MARY E. *See* ROSS, JAMES G., *et al.*

SANG, JAMES HENDERSON. Selection for Larval Development Rate Using Aseptically Cultured *Drosophila. Agricultural Research Council Poultry Research Centre, Edinburgh, Scotland.*

Larval development rate in *Drosophila* has a heritability of 20–25% and the character shows a notable degree of hybrid vigour in crosses. Selection from a cross shows progress only in the direction of slower development (Sang and Clayton, J. Hered. *48*:265) apparently since the fast developing larvae are always heterozygotes. As this situation may be typical of some cases of asymmetrical response to two-way selection it is important to explore the physiological mechanisms which may be involved. Earlier work (Sang, Caryologia, vol. suppl. 818) suggested two possibilities, both related to protein metabolism, which could be examined using aseptic nutritional techniques. Selection for larval development rate was therefore carried out on a diet deficient in casein and on a diet deficient in pyridoxine, which is the main vitamin involved in amino acid metabolism. In the first case, selection was successful only in the direction of slow development whereas responses were obtained initially in both directions using the pyridoxine deficient medium. Later the response declined in this case also, the heritability becoming zero.

Examination of the changes of some nutritional requirements resulting from both courses of selection will be described, and compared with what is known of the nutritional needs of pure lines and crosses. The limitations of nutritional techniques for this type of physiological study will also be considered.

SANTIBANEZ, S. KOREF. *See* PASQUALE, A. DI.

SARVELLA, PATRICIA. *See* BLICKENSTAFF, JOYCE; LIMA-DA-FARIA, A., *et al.*

SATO, IWANE, and IGOR L. KOSIN. Chromosome Complements in Parthenogenetic Turkey Embryos. *Department of Poultry Science, State College of Washington, Pullman, Wash., U.S.A.*

Work at the State College of Washington has demonstrated that turkey eggs from virgin hens show relatively high incidence of parthenogenetic development (Proc. Soc. Exper. Biol. Med. *93*:605). However, in only 4% of germ discs does truly embryonic formation occur; in 30% of the discs the development is limited to membrane and blood island formation. The development of such parthenogenetic embryos is retarded. For example, following 7 days of incubation the average parthenogenetic embryo approximates the stage of development reached by "normal" embryo after only 3 to 4 days of incubation. This delay seems to be due to low mitotic index of parthenogenetic embryos.

The diploid chromosome complement of turkeys is 18 macrochromosomes (including 2 sex chromosomes) for the male, and 17 (including 1 sex chromosome) for the female, and about 60 microchromosomes for both sexes. Chromosome counts on embryos and undifferentiated tissue from virgin eggs show nearly all nuclear plates of mitotic metaphase to be of diploid configuration. This suggests early duplication in parthenogenetically developing tissues. Our observations indicate the existence of considerable variation in the chromosome number of somatic diploid cells from parthenogenetic embryos and tissues. In these there also exist small nuclear plates with low chromosome numbers of the order of 10 macrochromosomes and 30 microchromosomes. Such haploid-like configurations can be seen not only in the undifferentiated cell groups but also in certain types of embryonic tissue cells, especially in erythroblasts, fibroblasts and epithelial cells. In these specimens the recovery of diploidy must have occurred after at least one division of the haploid female pronucleus: some cells then remained haploid without duplication. Doubling of chromosome sets frequently occurred in the diploid cells of parthenogenetic germ discs, leading to tetraploidy.

SAUL, GEORGE B. *See* WHITING, P. W.

SAVITSKY, HELEN. Chromosome Behavior in Interspecific Hybrids between *Beta vulgaris* L. and Species of the Section *Patellares* Tr. *Beet Sugar Development Foundation and U.S. Department of Agriculture, Salt Lake City, Utah, U.S.A.*

Hybrids between *Beta vulgaris* and species of the section *Patellares* are usually lethal and die in the seedling stage. Rare hybrids from Swiss chard × *B. webbiana* (obtained by J. O. Gaskill) survived but were completely sterile. The first semi-fertile hybrid was obtained by Dr. R. K. Oldemeyer of the Great Western Sugar Company from Turkish leaf beet × *B. procumbens*. Meiosis was studied in Gaskill's sterile hybrids, Swiss chard (*B vulgaris*) 2*n* × *B. webbiana* 2*n* and in Oldemeyer's semi-fertile hybrids Turkish leaf beet (*B. vulgaris*) 2*n* × *B. procumbens* 2*n*. Degrees of chromosome pairing and chiasma frequencies were a little higher in the semi-fertile hybrid with *B. procumbens* but were not sufficient for fertility. A certain grade of fertility in the hybrid with *B. procumbens* was due to the division of univalents and bivalents and to the regular and equal distribution of chromosomes in the first meiotic division. Because of the regularity of the first division, the composition of the chromosome set in some gametes approached the composition of the chromosomes in the non-reduced gametes. Such gametes contained almost a complete set of chromosomes from both species. The haploid gametes containing a few chromosomes from one species and a few from another species were not viable. Only diploid gametes or the gametes with an approach to the diploid number of chromosomes, and which had more chance to contain a complete haploid set of chromosomes of one species, were viable. Interspecific hybrids between two diploid *Beta* species could not survive on the diploid base. The progeny obtained consisted of triploids and aneuploids approaching to triploids. Different abnormalities in meiotic division were observed: breakage of chromosomes, bridges, telocentric and acentric fragments, non-disjunction, multipolar spindles, fused spindles, etc.

SAVITSKY, V. F. Differences in Interaction of Cytoplasm-Genes in Different Male-Sterile Races in *Beta vulgaris* L. *Beet Sugar Development Foundation and U.S. Department of Agriculture, Salt Lake City, Utah, U.S.A.*

In the process of repeated backcrossing of different *B. vulgaris* populations consisting of hermaphrodite plants, it was established that many hybrid populations segregated for male-sterile plants after backcrossing to monogerm beets. All occurrences of male-sterility were due to the interaction of male-sterile cytoplasm and the nuclear factors which do not restore pollen fertility in the presence of male-sterile cytoplasm. Genetic analysis of hybrids indicated that the appearance of male-sterile plants in backcross hybrids was caused by the presence of male-sterile cytoplasmic races in the multigerm hermaphrodite populations and elimination of the existing system of dominant genes which restored pollen fertility in these male-sterile cytoplasmic races. The process of substitution of dominant genes for recovery of pollen fertility by the genes causing abortion of pollen grains occurs faster in monogerm plants, because of linkage between non-recovery genes and the gene *m* (monogerm character). It is demonstrated that male-sterile cytoplasm isolated from different populations differs in this reaction to nuclear genes which do not restore male-fertility. These differences between plasms in the manifestation of the grade of male-sterility and in the interaction plasma-genes did not change during eight backcrosses and eight generations of selection for male-sterility within male-sterile lines. Different expressions of male-sterility in *B. vulgaris* L. are caused by different genes which influence the cytoplasm, as well as by the different types of male-sterile cytoplasm.

SAWIN, P. B., and D. D. CRARY. Chondrodystrophy (Da) in the Domestic Rabbit. *Roscoe B. Jackson Memorial Laboratory, Bar Harbor, Maine, U.S.A.*

A viable disproportionate dwarfism in the rabbit induced by the *Da* gene (incompletely dominant) results in *generalized* reduction in body size with greater effects specifically *localized*. In the skull, greatest retardation occurs in the endochondral bones. Prenatally, it is focused posteriorly in the basioccipital, but in adults it shifts anteriorly to the sphenoid elements, and corresponding compensatory adjustments occur in the adjacent membrane bones. Basally in the ear is a small papilla identifying homozygotes of all ages, even as early as 16 days prenatally when other characteristics are more subtly expressed. In the limbs the major reductions are proximally in the scapula and ilium, with lesser effects on the length of the more distal units—radius, ulna, metacarpals and metatarsals. Deficient development of glenoid fossa and acetabulum, accompanied by complete absence of the round ligament, may lead to severe adolescent crippling. If not severely crippled DaDa's will mate, conceive, and bear young, but are clumsy and rear their young with difficulty. In the vertebrae (and to a lesser degree in limbs) the generalized reduction can be recognized in the fetus at least as early as 22 days, and persists through life. Secondarily, it *interacts* with the species pattern of localized retardation of growth at successive ages (observations taken on 21 and 22 days prenatally, at birth, and in the adult) reaching its greatest expression in length or width of those parts or regions which are growing most actively at the time. These then are temporarily the critical regions. They are not the same through life, but change progressively with age, apparently an adjustment of regional gradients to generalized retardation. Histologically, the proliferative zone of cartilage shows an increase in intercellular matrix and consequent disorganization of the columns of hypertrophied cells, the relative effects of which appear to be similarly localized in time as well as place.

SCHACHT, LEE E. *See* GERSHOWITZ, HENRY.

SCHALET, ABRAHAM. A Study of Spontaneous Visible Mutations in *Drosophila melanogaster. Department of Zoology, Indiana University, Bloomington, Ind., U.S.A.*

Over 490,000 daughters of *Drosophila melanogaster* obtained by Muller's "Maxy" technique were examined for spontaneous visible mutations arising at 13 loci in their paternally derived X-chromosome. Simultaneously over 340,000 sons were examined for mutations in their maternally derived X-chromosome. Since sons were not scorable for lethal alleles or isoalleles, poorly scorable for mutations of wing and eye conformation, and often failed to breed, the estimates of mutation frequency given below are based on the daughters. At least one transmissible mutation involving each locus was found. The per-locus frequency of transmissible *independent* mutational events (totalling 39) averaged $(6 \pm 1) \times 10^{-6}$, and ranged from 9 for cut, down to one each among 490,000 for prune, echinus, outstretched small eye, carnation. The frequency of genetically proved *mutants*, including all those of common origin (a cluster of 10 cuts, one of 2 cuts, and one of 3 yellows) equally with the 36 that arose singly, averaged $(8 \pm 2) \times 10^{-6}$ per locus. Tests of lethal frequency among representative chromosomes of paternal origin gave 32/8,706, about double the rate sometimes considered as standard. This would make the "standard" per-locus rates of visible mutations about half of those above. Since several cases were proved deficiencies, the per-locus rates for gene mutations are somewhat lower still. The ratio of fractional to apparently whole-body *independent* mutations was 20:19 for proved alleles of specific loci and 38:21 for untransmitted "mutations" (including very few possible phenocopies) of fertile individuals having corresponding phenotypes. Since even the last cited 21, being untransmitted, must have been fractional, there are only 20 possibly whole-body to nearly 78 fractional cases. Most spontaneous mutations therefore occur in early cleavage and/or mature germ cells. Moreover, for every individual with a newly arisen germinal mutation there are some 3 or 4 that undergo comparable impairment owing to somatic mutation. (This work was supported by a grant to Dr. H. J. Muller and associates from the U.S. Atomic Energy Commission (Contract AT (11-1)-195).)

SCHECROUN, JANINE. Sur la réversion provoquée d'une modification cytoplasmique chez *Podospora anserina. Faculté des Sciences de Paris, Laboratoire de Génétique, Paris, France.*

Chez l'ascomycète *Podospora anserina*, le couple de gènes *S s* conditionne la formation d'un barrage entre souche *S* et souche *s*. Ce barrage n'empêche pas la fertilité du croisement $S \times s$, et dans sa descendance, on trouve régulièrement à la place des souches s des souches modifiées s^S qui ne donnent pas de barrage avec S. La forme s^S est interprétée comme résultant d'une modification cytoplasmique de la forme s. s^S peut réverser vers s spontanément avec fréquence faible, ou régulièrement par suite d'un contact cytoplasmique entre filament s^S et filament s et en l'absence de toute migration de noyaux s. Lorsque la réversion a débuté en un point, elle progresse à l'intérieur du filament d'une manière continue; la vitesse de progression croit beaucoup avec la température et peut atteindre 7cm./jour dans les meilleures conditions.

Si l'on admet que : s et s^S ont le même noyau, que s possède dans son cytoplasme des éléments particulaires, que ces éléments absents dans s^S peuvent y apparaître spontanément et s'y multiplier, que S inhibe leur multiplication, on peut rendre compte de tous les faits connus.

SCHERR, GEORGE H. *See* RIPPON, JOHN W.

SCHMALHAUSEN, IVAN. Hereditary Information and Its Transformations. *Academy of Sciences of the USSR, Moscow, U.S.S.R.*

The mechanism of evolution is regarded from the viewpoint of cybernetics. Since population is the least evolving unit, it is the regulated object. Biogeocoenose plays the role of the regulator. Population is connected with it by two channels of communication. The first is on the molecular level of organization and transmits hereditary information from the zygote to primitive germ cells of the adult individual. The second channel, on the organization level of an individual, transmits feed-back information from phenotypes to the biogeocoenose. Between these two channels transformation mechanisms connect the channels and circuit the elementary cycle of evolutionary changes. Alternation of two pairs of bases in the molecule of DNA gives a vast number of possible combinations ensuring deep individuality of each molecule, since the number of the links in a long chain molecule is great. Hereditary information is transmitted through the mechanism of cell-division by chromosomes which are the regulators of intracellular metabolism and individual development. The essence of individual development, realized in morphogenous mechanisms by the use of amplifiers, consists in transformation of hereditary information into a system of life relations of the phenotype to its environment. Natural selection is accomplished on the basis of the evaluation of the phenotype. This is the mechanism of transformation of the feed-back information in the biogeocoenose. Transformation is completed by the reorganization of hereditary information in zygotes. Random environmental influences are "noises" disturbing the information. Elimination of deviations, i.e., stabilizing selection, leads to the increase of "noise" reduction. Reiteration of information is realized by repetition of similar genes, of their complexes and of entire chromosomes in a diploid organism. The system of internal connections is used both in the structure of genes and chromosome linkage and in the set arrangement of chromosomes. The hereditary code is isolated by its position under the protection of regulatory mechanisms of the cell. Stability of the transforming mechanism of information in ontogenesis is maintained by means of internal relations in the regulatory systems. Reliability of the feed-back information is ensured by the organization of the phenotype, by repetition of all essential characters in each individual, by means of protection and isolation from disturbances.

SCHOLZ, F. Smooth-awned Barley Mutants Induced by X-Rays. *Institute for Research of Cultivated Plants, Gatersleben, of the German Academy of Sciences, Berlin, Gatersleben, Kreis Aschersleben, Germany.*

Mutation experiments by means of X-rays have been pursued at Gatersleben (Germany) for about twelve years on both spring and winter barley. Up to now about 800 mutants have been isolated. Among many high-yielding mutant strains which are valuable for breeding purposes, there are several semismooth mutants, such as a smooth-awned one (Mut. 4033), of special interest. Most of the mutants descend from the two-rowed, rough-awned variety, Haisa. In yield trials since 1951 these mutants have been unquestionably superior to Haisa. But another smooth-awned mutant (Mut. 4034) has shown high-grade partial sterility (on an average 70–80%).

Several authors emphasize that smoothness of awns is very closely associated with hairless stigmas. This property may prevent the normal reception of the pollen, resulting in a relatively high number of sterile spikelets, and eventually in lower yields. Our high-yielding Mut. 4033, however, has moderately haired stigmas; its fertility is nearly normal. Moreover we can show that smooth-awned barleys in the Gatersleben World Collection may have all gradations from hairless to normally haired stigmas.

Crossing the mutants with each other as well as with Haisa indicated three independent recessive genes for semi-smoothness. In both the smooth-awned mutants a multiple allelic series is involved which is independent of the above-mentioned genes. The dominant allele is responsible for rough awns of Haisa. Smoothness of the awns of Mut. 4033 is governed by the one recessive allele. The third allele (Mut. 4034), being recessive to that of Mut. 4033 also, is responsible for the same grade of smoothness as well as for extreme partial sterility and, to all appearances, hairless stigmas. Thus in one locus there may be various mutations for smooth awns affecting hairiness of stigmas and fertility differently. Studies on allelic relations to r-genes have been started.

SCHREIBER, GIORGIO, A. R. HOGE, H. W. BELLUOMINI, and A. M. PENHA. Further Researches on Intersexuality in a Highly Isolated Population of Snakes. *Instituto de Biologia, University of Minas Gerais and Instituto Butantum, Sao Paulo, Brazil.*

At the IX International Congress of Genetics (1953) we presented the problem of *Bothrops insularis* Amaral, a crotalid from the island of Queimada Grande (South Atlantic–Brazil). Further results of 5 years of research are now reported, with new statistical data and embryological findings.

This snake presents the sexual abnormality of the presence of a hemipenis (bilateral or unilateral) in a great majority of the females. The true females (without hemipenis) are probably sterile and the females with hemipenes bear a smaller number of developed embryos than do females of related species.

Three problems have been studied: first, the genetic sex of the abnormal individuals; second, the development of the gonads in normal and abnormal embryos; and third, the sex ratio in the population during almost 35 years of capture.

The snake is restricted to this island and no other crotalid snake exists in the same territory (almost half a square mile of surface).

The embryological researches show that those with testis always bear well-developed bilateral hemipenes. The embryos with ovaries and Mueller ducts can bear bilateral hemipenes (more or less developed), unilateral hemipenes (generally right) or none (true females). The abnormal individuals are thus embryologically females.

The genetical sex of the abnormal individuals has been determined by the statistical analysis of the scaling. The ventral scale number is a true somatic sexual character being determined very early during the segmentation of the mesoderm into somites and thus independent of the influence of gonadic sex hormones.

The statistical distribution of this character in the abnormal individuals shows clearly that it falls in the field of the true females. A further statistical analysis carried on with the method of the "discriminant function" between two groups of three characters each confirms this result with considerable evidence.

The sex "ratio" in the population shows a trend of reduction of number of males and true females, and increase of the number of abnormals. The fact that the abnormal individuals are genetically females indicates that their increase is independent of the decrease in the number of males probably carrying a lethal factor and is not due to a transformation of the male gonads into ovaries.

The significance of the abnormality is considered and the term *intersexuality* (Padoa) is used here in a broad sense. A new term "arrenoidism" (females bearing a unique male character) is suggested and the problem of the probable extinction of the species in the island because of the continual and evident diminution of the males is discussed.

SCHULTZ, JACK. The Nature of Variegation in *Drosophila. Institute for Cancer Research, Philadelphia, Pennsylvania, U.S.A.*

The variety of types of mosaic found in *Drosophila* fall into a number of categories: heterochromatin-induced variegation, that is, changes in the expression of loci correlated with transposition to or from heterochromatic regions; gross chromosome changes; somatic crossing-over; somatic mutation *sensu stricto*, and miscellaneous variations in patterns of mutant expression, correlated with cell lineage. The last group is a nondescript one at present; perhaps it provides material for the analysis of the genetics of differentiation. The others are better understood.

The genetic system underlying heterochromatin-induced variegation may be considered responsible for the integrative control of nucleic acid synthesis in the organism. The lines of evidence supporting such a statement are: (1) the cytological and cytochemical analysis of changes adjoining the loci of the associated rearrangements; and (2) the metabolic analysis thus far of the variegation phenomenon (response to antimetabolites affecting nucleic acid synthesis to changes of nutrition, etc.). Against this background, the genetic inter-relations of the numerous modifiers of variegation will be examined, and their relation to the heterochromatic regions, both intercalary and centric, discussed. The various degrees of specificity displayed by these modifiers, and their relationship to the effect of distance from point of rearrangement and to other properties of the variegation phenomenon, will be shown.

The apparent contrast between the variegation due to somatic crossing-over and the heterochromatin-induced variegation will be examined as an expression of the relation between the behavior of the chromosomes as orgamelles (somatic crossing-over) and the replication of their individual units. The relation between the maize and *Drosophila* variegation will also be considered in these terms. Finally, the inter-relations between these problems and those of nuclear differentiation during development will be discussed.

Schwartz, Drew. A New Mutable Gene in Maize. *Biology Division, Oak Ridge National Laboratory, Oak Ridge, Tenn., U.S.A.*

A spontaneously occurring mutational system at the *c* locus in maize is under investigation. This highly mutable recessive allele, c^m, mutates to both a stable *C* and a stable *c*. Mutations can occur in the sporophyte and gametophyte, as well as in the endosperm. The mutability of c^m is autonomously controlled and is not associated with any detectable chromosome breakage. It is completely independent of the *Ac-Ds* system.

The c^m gene is stable in the zygote and does not mutate. This stable condition is maintained until some time during ontogeny when the gene becomes unstable and free to mutate. The time at which the shift to instability occurs is determined by the state of c^m. Three distinct states can be recognized. In the late state, the stability is maintained until after fertilization and mutations occur only in the endosperm. In the intermediate state, the shift occurs some time around meiosis so that some mutations occur before fertilization, giving rise to self-colored kernels. In the early state, the c^m gene becomes unstable in the young sporophyte giving rise to large mutant sectors on the ears. At fertilization, those genes in the zygotes that have not as yet mutated revert to the stable condition and the cycle is repeated.

Schwemmle, Julius, C. G. Arnold, and H. O. Glenk. Preuve et bases chimiques de la fertilisation sélective chez les Œnothères. *Botanisches Institut der Universität, Erlangen/Bayern, Allemagne.*

La fertilisation sélective *sensu stricto* doit être opposée à ces processus de sélection qui empêchent une combinaison libre et fortuite des gamètes avant que les cavités des ovaires soient atteintes par les tubes polliniques (concurrences des tubes polliniques, du sac embryonaire, facteurs de létalité entre autres).

La fertilisation sélective *s.s.* repose sur une réaction chimique directe entre gamètes mâles et femelles.

C'est Schwemmle à Erlangen qui a prouvé clairement avec des espèces d'œnothères et pour la première fois ce phénomène depuis longtemps discuté. Les espèces d'œnothères sont particulièrement favorables par suite de leur constitution génétique (formation des complexes des chromosomes).

Lors du croisement de *Oenothera Berteriana* (symbole de complexe B et l) avec *O. odorata* (v et I) la combinaison B·v manque. On peut éliminer toutes les causes qui pourraient expliquer le manque de B·v excepté la fertilisation sélective. Une preuve directe par la méthode de pollinisation complémentaire est possible (plantes B·l pollinisées par du pollen v donnent seulement l·v; une pollinisation suivante et complémentaire avec pollen I donne alors toujours B·I). Ainsi les ovules B n'attirent pas les tubes polliniques v.

On a constaté aussi plus tard une fertilisation sélective dans d'autres espèces d'œnothères.

Les ovules secrètent des substances qui attirent chémotropiquement les tubes polliniques. La force de l'attraction est différente suivant la constitution génétique des gamètes: les gamètes ont des affinités différentes les uns par rapport aux autres. Mesure pour l'affinité: taux d'apparition d'une certaine combinaison zygotique de complexes (par exemple, affinité B — v = O). L'affinité entre ovules et tubes polliniques peut être aussi constatée *in vitro* (expérience de chémotropie).

But des recherches suivantes : isolement et identification des substances à action chémotropique secrétées par les ovules = "Gamones" des plantes supérieures.

SCHWINCK, ILSE, and ELIJAH ADAMS. Biosynthesis of Tyrosine from Prephenic Acid in *Escherichia coli* Mutants. *New York University College of Medicine, Department of Pharmacology*, and *Columbia University, Department of Zoology, New York, N.Y., U.S.A.*

Tyrosine is made from phenylalanine in animals, but not in *Escherichia coli* as indicated by growth experiments with mutants. Direct proof of this has been obtained in recent studies (Schwinck and Adams, Fed. Proc. *17*, in press, 1958) of a soluble enzymatic system which catalyzes tyrosine synthesis from a non-aromatic precursor, the cyclohexadien prephenic acid (PPA). PPA had already been established as a phenylalanine precursor in *E. coli* (Weiss *et al.*, Science *119*: 774, 1954). An independent aromatization in tyrosine formation leads from PPA to p-hydroxyphenylpyruvic acid (HPP), which is convertible to tyrosine by transamination. Prephenic dehydrogenase, the enzyme catalyzing the reaction to the phenolic compound, was partly purified and found to require DPN. Quantitative assays and identification were based on UV-spectra, derivatives and paper chromatography. Essential support for the independence of the aromatization reactions to phenylalanine or to tyrosine comes from enzyme studies with mutants: prephenic dehydrogenase is absent from two independently derived tyrosine auxotrophs which do not require phenylalanine for growth, but the enzyme is active in extracts of the phenylalanine auxotroph 83-5. Mixed incubations with extracts from separate mutants revealed no inhibitory effects. An observation of separate interest indicated that addition of tyrosine to the growth medium of 83-5 results in markedly depressed specific activity of the prephenic dehydrogenase, suggesting this system as an additional case of negative feed back control of the enzyme.

SCOSSIROLI, RENZO EDOARDO, and SAVINA SCOSSIROLI. Response to Selection for Quantitative Traits in Isogenic Populations of *Drosophila melanogaster*. *Istituto di Genetica, Pavia, Italy.*

Selection for sternopleural hairs was started in two isogenic populations of *Drosophila melanogaster* soon after isogenicity was reached. Both control and X-rayed lines responded promptly to selection. The results are interpreted in terms of mutations in the polygenic systems responsible for bristle number. Lines derived from reciprocal crosses between isogenic strains also responded to selection. In this case recombination within polygenic systems probably plays the major role in determining the response to selection.

SCOSSIROLI, SAVINA. *See* SCOSSIROLI, RENZO EDOARDO.

SCOTT, J. P., and JOHN L. FULLER. Genetics and Social Behavior in Dogs. *Roscoe B. Jackson Memorial Laboratory, Bar Harbor, Maine, U.S.A.*

This paper reports results from a ten-year experiment whose purpose was to discover the extent to which heredity can affect behavior (and particularly social behavior) within a species, and the mechanisms through which this is accomplished.

Dogs of five different breeds representing the important groups selected by breeders for behavioral differences were raised in a standard environment and given a series of behavioral tests and measurements from birth until one year of age. Two breeds, African basenjis and American cocker spaniels, were used in a Mendelian cross, and the hybrids studied in a similar manner. The data from some 450 animals were eventually studied by analysis of variance, factorial analysis, and other statistical techniques.

Breed differences were important in most of the variables studied, but individual (including environmental) and substrain variation was always present in considerable amounts.

The hybrid populations showed several different patterns of inheritance in different behavioral variables: dominance, no dominance, hybrid superiority, and complex interaction. Differences between reciprocal crosses were important in several cases. Multiple factor inheritance was indicated in nearly all.

Breed differences can appear at any age, and may either be magnified or reduced by a constant environment. Variability of behavior in an individual is decreased by habit formation. Each breed inherits a number of basic capacities and simple behavior tendencies which can be easily organized by learning into the complex capacities for which the breed has been selected. Behavior is therefore in part genetically organized through simple behavior patterns and gene combinations, and in part environmentally organized through learning and habit formation. Possible applications to human problems are discussed.

SCOTT, J. P. *See* FULLER, J. L.

SEARS, E. R., and M. OKAMOTO. Intergenomic Chromosome Relationships in Hexaploid Wheat. *U. S. Department of Agriculture* and *University of Missouri, Columbia, Mo., U.S.A.*

The 21 chromosomes of *Triticum aestivum* can be placed in 7 homoeologous groups of 3 according to the ability of tetrasomes to compensate for particular nullisomes. Within these groups all the 42 possible tetrasomic-nullisomic combinations are nearer normal than the nullisomics themselves. Between the groups nearly 50 different combinations have been tested, without any of them showing compensation. The high degree of compensation exhibited in most of the combinations within groups indicates that almost every chromosome is very similar to its two homoeologues in gene content. The homoeologous chromosomes show little tendency to pair, however, for the bivalent frequency in haploids normally averages only about one.

That the pairing in haploids usually involves homoeologous chromosomes has been shown by analysis of translocations recovered from haploids, where each translocation is presumably the result of haploid pairing and crossing over. Of the 13 translocations analysed, 9 involved homoeologous chromosomes: VI–XIX (4 occurrences), II–XX (2), XI–XXI (2), and XII–XVI. The other 4 were: II–VIII, IV–XII, VI–XVIII, and IX–XI.

The virtual failure of homoeologous chromosomes to pair appears to be due to suppression of pairing by chromosome V. When chromosome V is missing, hybrids of hexaploid wheat (genomic formula AABBDD) with amphidiploid *T. aegilopoides* × *Aegilops squarrosa* (AADD) show many microsporocytes with the equivalent of the expected 14 bivalents (average over 12), but only rarely have as many as 13 bivalents (average about 8) when V is present. Hybrids of AABBDD with AA, which normally have only 2 to 7 pairs, have the equivalent of 5 to 13 pairs (average about 10) when chromosome V is missing. It seems likely that the acquisition of a mutation on chromosome V which decreases pairing intensity is the means by which hexaploid wheat has achieved diploid pairing. As demanded by this hypothesis, pairing is definitely less intense in hexaploid than in diploid wheat.

SERMAN, D. *See* HARTMAN, P. E., *et al.*

SERMONTI, GIUSEPPE, and GIORGIO MORPURGO. Chemio-Reactivation in *Penicillium chrysogenum. Istituto Superiore di Sanità, Rome, Italy.*

Diploid conidia of *Penicillium chrysogenum*, inactivated by a nitrogen mustard (HN-2), have been reactivated by $MnCl_2$ added to the plating medium. When the survival of the HN-2-treated conidia on the unsupplemented medium is superior to 0.02, the killing effect is almost completely suppressed on the $MnCl_2$-supplemented medium. Once the reactivated clones have started to grow on the $MnCl_2$-medium, they do not require $MnCl_2$ for further development. The reactivating effect of $MnCl_2$ is much less remarkable on haploid conidia than on diploid ones. No reactivation by $MnCl_2$ has been observed on conidia inactivated by ultraviolet or X-rays. After nine hours' incubation of the HN-2-treated conidia in a nutrient medium the efficiency of the reactivation has not been affected. $MnCl_2$ is also effective in reducing the rate of HN-2-induced somatic segregation from heterozygous diploid conidia, and in inhibiting the spontaneous segregation of HN-2-induced unstable clones.

SERMONTI, GIUSEPPE. *See* MORPURGO, GIORGIO.

SERRA, J. A. Two-dimensional Composite Nature of the Gene. *Institute of Zoology, Faculty of Science, Lisbon, Portugal.*

A series of facts relating to isoalleles and position effects and also recent results on pseudoalleles may be explained by the composite model of the gene which we developed several years ago (Serra, Bol. Soc. Broter. 2s *19*: 327–369; Portug. Acta Biol. (A), 1949). The gene has been represented as a composite, along the chromonema, of one to several segments of chromonema (nemameres). Gene mutations and position effects of the mimic type consist in changes in the contacts between successive segments, respectively within and between the genes. Other position effects are of the pure type, not mimic to known gene mutations. Pure position effects are potentially new genes, and repeats should provide the most frequent process of their origin.

This model also considered the composite nature of the gene according to its diameter. However, it applies only to macro-organisms and may need to be simplified when applied to micro-organisms. To draw a conclusion from the diameter of one chromoneme, it is certain that each gene is composed of several fibrils. Electron micrographies clearly show about 6–8 orders of fibrils, down to about 40 Å (diameter of two double polynucleotide or polypeptide chains), each fibril formed of two of the next inferior order. So-called gene conversion or transmutation may be explained by the sorting-out or cross-sorting of different fibrils within a gene, when cross-over takes place. If, to simplify, we suppose there are only two double fibrils in each chromoneme, then a heterozygote would normally be *aa.aa/AA.AA*. If by partial mutation $a \rightarrow A$, or by a former somatic cross-over or asynchronous reduplication, it becomes *AA.AA/Aa.aA*, a 3:1 tetrad of $AA+AA+AA+aa$, or a 4:0 of $AA+AA+Aa+Aa$ may result, as found in several cases. In meiosis this process should be linked with, but independent of, crossing-over. Sorting-out may also explain negative chromatid interference, somatic cross-over and some cases of gene instability.

SHAPIRO, N. *See* BREWBAKER, J. L.

SHARMA, ARUN KUMAR. Aesculin: Its Use in Detecting Double Fertilization and Chromosome Structure of Various Organs of Plants. *Cytogenetics Laboratory, Botany Department, Calcutta University, Calcutta, India.*

To cytologists and geneticists, it often becomes imperative (especially after cross breeding) to determine the occurrence of fertilization and double fertilization leading to endosperm development in higher plants. Pollen tube smear technique is not suitable and other classical cytological methods are often too time-consuming for a breeder.

Aesculin has already been used in the clarification of chromosome structure of roots and leaves (Sharma and Sarker, 1956; Sharma and Sharma, 1957). It is now possible to employ this chemical effectively in the clarification of chromosome structure of endosperm and embryo tissue. With the aid of the following schedule, the nature of the endosperm—its triploid constitution following double fertilization—can be demonstrated in four hours or less. Ovules are treated in approximately 3% aesculin solution for 3 hours at a temperature of 10–12°C. The ovules are then fixed in acetic-alcohol (1:1) for 30 minutes. The materials are next heated in a mixture of 2% aceto-orcein and N/HCL (9:1) for a few seconds. After ten minutes, they are smeared in 1% aceto-orcein solution. In such preparations the number of chromosomes is readily ascertained both in the endosperm and in the embryo, and chromosome morphology is clearly delineated. In the study of pollen grain chromosomes, the use of aesculin has also been found to be advantageous in that the least contraction of chromosomes in a perfectly scattered plate can be secured.

It has been shown that in the same individual the concentration of aesculin and the period of treatment necessary for the clarification of chromosome structure in different organs vary to a considerable extent. They are decidedly different for leaves, stem-tips, roots, ovules and pollen grains. This is an indication of the differential constitution of the cytoplasmic set-up of these various organs. It has been shown that aesculin causes viscosity changes in the cytoplasm.

SHEPPARD, P. M. *See* CLARKE, C. A.

SHULTZ, FRED T. *See* ANDERSEN, A. C.

SIEGEL, ALBERT, A. NORMAN, and W. GINOZA. The Inactivation of Tobacco Mosaic Virus by Ultraviolet Light. *University of California, Los Angeles, U.S.A.*

Strain U1 of tobacco mosaic virus is 5½ times more resistant to inactivation by ultraviolet light than strain U2. The infectious nucleic acids derived from these strains, however, are both equally sensitive to ultraviolet light. Moreover, the nucleic acids have a sensitivity equal to that of the intact U2 strain. Thus the genetic material of the intact U1 strain is protected from the damaging effects of ultraviolet light. The presence of water is necessary for this protection. When the U1 strain is irradiated dry, it has the same sensitivity as the U2 strain. Drying of the U2 strain does not affect its sensitivity. The above data were obtained with irradiation of wavelength 254 $m\mu$. When the two strains are irradiated at 226 $m\mu$, they have approximately the same sensitivity. At this wavelength, strain U1 is approximately five times more sensitive than at 254 $m\mu$, while strain U2 is almost equally sensitive at the two wavelengths. At wavelength 254 $m\mu$, the nucleic acid component of the virus accounts for approximately 80% of the total absorption of the virus, while at 226 $m\mu$ the nucleic acid absorbs only a minor fraction of the total energy absorbed. It is postulated that absorption of energy either by the nucleic acid or by the protein portion of the virus can lead to inactivation of the U2 strain. Absorption of energy by the nucleic acid of the U1 strain is relatively ineffective and the inactivation of this strain is due mainly to absorption of energy by the protein. When inactivation is a result of absorption of energy by protein, the energy is apparently transferred to the nucleic acid and the nucleic acid becomes damaged. This is demonstrated by the fact that nucleic acid extracted from irradiated U1 strain is found to be inactivated to the same extent as the parent virus.

SILVESTRONI, E. *See* SINISCALCO, MARCELLO, *et al.*

SINGLETON, W. RALPH, and ALAN L. CASPAR. The Blandy Radiation Field for Inducing Mutations in Plants. *Blandy Experimental Farm, University of Virginia, Charlottesville, Va., U.S.A.*

The Blandy radiation field, or pit, is designed to give short rather than long exposures of chronic radiation. Plants are grown in pails and moved to the radiation area which consists of a paved circle 30 feet in diameter, shielded by a concrete retaining wall and an earthen embankment. The 125 curie Co^{60} machine is located in a dry well in the center of the field. The source is raised by remote control through a stainless steel pipe to the operating position. A "sky shine shield" consisting of three tons of concrete blocks on an oak table limits the radiation upward that would be reflected to earth by particles in the atmosphere.

The Co^{60} machine was loaned to us by the Division of Biology and Medicine of the Atomic Energy Commission. Cost of the field exclusive of the machine was approximately $5,700. (Research work was supported by grant from the Atomic Energy Commission, A. E. C. Contract No. AT-(40-1)-2071.)

SINISCALCO, MARCELLO, T. BIANCO, G. MONTALENTI, and E. SILVESTRONI. Effect of Thalassemia on the Pattern of Some Physical Measurements. *Istituto di Genetica, Università di Napoli, Naples, Italy.*

By studying the distribution of some physical measurements (stature, weight, cephalic indexes, etc.) in a sample of families derived from a thalassemic area (Berra, District of Ferrara, Italy) some evidence is put forward in favour of the conclusion that the thalassemic gene produces some direct effect on the pattern of these measurements. Apart from considerations relating to the genetic problem of thalassemia, the authors stress some general implications of these observations. The possibility that a single gene difference might alter more or less directly the pattern of some classical physical measurements seems to be an important point for the physical anthropologist to bear in mind.

SINOTÔ, YOSITO. Graft Experiments on Eggplants. *Department of Biology, International Christian University, Mitaka, Tokyo, Japan.*

Graft experiments have been carried out on several varieties of eggplant since 1951, in order to re-examine the results of the Lysenkoists who obtained vegetative hybrids. The results of the present work were published in part in 1955. (The Japanese names of the varieties are given.)

(1) Kantôao (KA, blue fruits) was grafted on Sinkuro (B, black fruits). Twenty were successfully grafted of which 16 bore fruits in the branches of the scions. In 9 plants the fruits were blue, while in the other 7 plants they were black. (2) Sinkuro (B) was grafted on Kantôao (KA). Of 4 grafted plants 2 showed that the fruits on the stock (KA) were all blue, while in the other 2 plants bodies, leaves and fruits of the stocks (KA) all changed to black. (3) The first generation raised from seeds obtained by selfing in the blackened fruit borne on the scion (KA) showed segregation into the two types of plants: 25 blues and 10 blacks.

The author has tried to interpret these data hypothetically from the standpoint of biochemical and physiological genetics, especially by means of the concept of actant which has been advocated by the author since 1938 (Kagakugahô *27*, 1938, 1945; Novant' anni del leggi mendeliane, Rome, 1955; Kagaku *25*, 1955).

SISKEN, JESSE E. The Synthesis of Nucleic Acids and Proteins in the Nuclei of *Tradescantia* Root Tips. *City of Hope Medical Center, Medical Research Institute, Duarte, Calif., U.S.A.*

An attempt has been made to correlate the synthesis of nucleic acids and some proteins of the nucleus with events of the mitotic cycle. By means of radioisotopes and the autoradiographs, the incorporation of specific precursors into nuclei of *Tradescantia* root tips was determined. Interphase, the period between division stages, may be divided into three sub-phases. In the first, the nucleus enlarges but does not incorporate tritiated thymidine. Since thymidine is a specific label for deoxyribonucleic acid (DNA), growth of the nucleus must occur without the synthesis of DNA. In the second sub-phase, which occurs when the nucleus has reached a certain size, incorporation of thymidine occurs without further increase in size. Data derived from cells in stages of division show that there is a third phase between the period of DNA synthesis and prophase which requires about eight hours. To obtain information concerning the time of synthesis of ribonucleic acid (RNA), the incorporation of C14-orotic acid, a precursor of both types of nucleic acid, was studied. The uptake of isotope into both RNA and DNA was determined by studying two comparable sections of the same nucleus after RNA had been removed from one by hydrolysis in N HCl at 60°C for 7 minutes. Data indicate that at the time of synthesis of DNA, there is little or no synthesis of RNA and that most of the RNA of the nucleus is synthesized just prior to the synthesis of DNA. There is a secondary period of RNA synthesis following DNA synthesis. The synthesis of nuclear proteins which are not removed by the Feulgen hydrolysis was studied using C14-lysine. The data indicate that protein synthesis probably occurs in all stages of the cell cycle.

Skalinska, Maria. Some Attempts to Obtain Hybrids between *Aquilegia* and *Isopyrum*. *Institute of Plant Anatomy & Cytology, University of Krakow, Krakow, Poland.*

The degree of relationship between some genera may sometimes be estimated from their crossability. *Aquilegia* and *Isopyrum* are regarded by taxonomists as closely related genera. They have the same number of chromosomes ($2n = 14$) and they belong to the group of Ranunculaceae with very small chromosomes (Gregory, 1941). In order to test their crossability, the most primitive species of *Aquilegia, A. ecalcarata* Maxim. was chosen. The first stages of development after cross-pollination seemed promising. Germination of pollen tubes of *Isopyrum thalictroides* L. on the styles of *Aquilegia*, although inferior to that after selfiing, was observed. Fertilization occurred 3 to 6 days after pollination and was followed by the development of the endosperm. After 9 days some apparently normal ovules contained 350 to 437 free endosperm nuclei and in some others the transition to the cellular state was observed. The first division of the zygote occurred 5 to 7 days after pollination. The embryos however attained only the stages of 3 to 8 cells (exceptionally, 14 cells) before the beginning of abortion. In most ovules also the endosperm has in later stages an impaired growth. Its breakdown is not bound to a definite stage; it takes place in various stages of development. The poor viability of the hybrid embryo is not regularly correlated with that of the endosperm; it seems to result rather from its genetic constitution. During experiments in three successive years only non-germinating seeds with well-developed seed-coat and sometimes well filled with endosperm but without embryo were obtained.

Slatis, Herman M. An Analysis of Inbreeding in the European Bison. *Argonne National Laboratory, Lemont, Ill., U.S.A.*

In connection with the study of inbreeding in man, a survey was made of the possibility of obtaining information about inbreeding in other large mammals. It was hoped that inbreeding could be studied through the use of zoo records of mammals from wide-ranging, numerous species, such as giraffes or zebras. Inquiry indicated that such records are available in only a few cases. However, the existence of excellent data on the European Bison was pointed out.

At the present time there are almost 200 living European Bison and individual records exist for about 400 additional specimens, including almost all the animals kept in captivity within the preceding 60 years. All the living animals are at least the third generation in captivity and a few can be traced in some lines through 10 generations. The living bison trace back to a set of 17 ancestors, of which only one was born in captivity.

The coefficient of inbreeding, F, has been calculated for all of the animals on the assumption that the 17 original animals were unrelated to each other. Mortality is quite similar at all levels of inbreeding, with little or no indication of early death being correlated with inbreeding. F may not be a satisfactory index for this study. An alternative index has been developed, *ll, the likelihood of death if a given ancestor possessed a recessive lethal gene heterozygously.* This index also shows little correlation with early death.

Given sufficient data, the comparison of inbreeding as measured by F and by *ll* will provide information on the roles of homozygosity for many loci as opposed to homozygosity for specific lethal loci in the reduction of viability that is noted in inbred populations.

(This work was performed under the auspices of the U. S. Atomic Energy Commission.)

SLIZYNSKI, B. M. Chiasmata in Female Mice. *Institute of Animal Genetics, Edinburgh University, Edinburgh, Scotland.*

At the present stage of technique it is impossible to count chiasmata in oocytes at the diplotene stage. The data have been collected on chiasma frequency of 50 oocytes at metaphase stage. In comparison with analogous data for spermatocytes, females have more chiasmata per nucleus and per bivalent than males. The mean chiasma frequency per bivalent is in females 2.03 and in males 1.71. Estimated diplotene map length of the whole complement for females is about 2,130 cM, i.e., about 10% more than the 1,896 cM long diplotene map of the male hybrid animals. It is possible that cytological differences in behaviour of sex bivalents in females and in males may be correlated with the sexual dimorphism in the frequency of chiasmata and recombination.

SMITH, BEN W. Polyploidy, Hybridization, and Sexuality in Dioecious *Rumex hastatulus* and *Rumex paucifolius*. *Genetics Faculty, North Carolina State College, Raleigh, N.C., U.S.A.*

The cytogenetics of sex determination in circumboreal *Rumex acetosa* L. and its allies is well known: $^{X}/A$ balance; $2n = 14,15$; X versus Y_1Y_2 in the heterogametic males. The two American species of the subgenus Acetosa are also dioecious, but differ markedly from *R. acetosa* and from each other both in chromosome number and morphology. *Rumex hastatulus* Baldw. is an annual weed of the Southeastern Coastal Plain. Females are homogametic ($n = 3 + X$); males are heterogametic ($n = 3 + X$ or $3 + Y_1Y_2$). The combination $3A + 2X + Y_1Y_2$ produced a unisexual male; $4A + 3X + Y_1Y_2$ resulted in males and male intersexes. This suggests an X/A balance with a critical value near 0.75, but does not exclude the possibility that the Y-chromosomes influence sex determination. *Rumex paucifolius* Nutt., a perennial subalpine of the western mountains, includes at least two chromosome races, $2n = 14, 28$. Chromosome morphology and meiotic behavior reveal the autopolyploid nature of the 28-chromosome forms. The diploid is known from a single collection. We have not observed heteromorphic sex chromosomes.

Reciprocal crosses between *R. hastatulus* and *R. paucifolius* ($2n = 28$) have both produced F_1 hybrids. The hybrid population was dioecious; no intersexes occurred. Of the 51 hybrids 6 were vigorous, "neuter" plants which failed to produce any flowers or flower parts. With *R. paucifolius* as pollen parent all hybrids received 18 chromosomes. Sex was determined by heterogamety in *R. paucifolius.* Following the reciprocal cross, female hybrids contained 18 chromosomes; 14 from *R. paucifolius,* 4 from *R. hastatulus.* The 19-chromosome males received 5 chromosomes ($3 + Y_1Y_2$) from *R. hastatulus.* At metaphase I in PMC's, there are 7 bivalents and 4 or 5 univalents. As the *R. paucifolius* bivalents disjoin, the *R. hastatulus* univalents divide. The daughter chromosomes usually reach the poles. From thousands of florets, we obtained only 50 viable F_2, backcross, and open-pollinated seed. In the resulting plants, the parental chromosomes occurred in various new combinations which have been correlated with sex expression.

SMITH, HAROLD H. Limits and Consequences of Multiple Allopolyploidy in *Nicotiana. Biology Department, Brookhaven National Laboratory, Upton, Long Island, N.Y., U.S.A.*

A multiple allopolyploid *Nicotiana bigelovii-debneyi-tabacum* ($n = 72$) was produced by crossing the amphidiploid *N. debneyi-tabacum* ($n = 48$) with *N. bigelovii* ($n = 24$) and doubling the chromosome number with colchicine. Cultures were continued by self-pollination and selection for three distinct races through the S_{10} generation. Each race has become established at a different high aneuploid number of chromosomes ($n = 50$ to 60) and irregularities in meiosis persist. Pollen abortion has been reduced to 3.7% in race A, 15.7% in race B, and 8.5% in race C. Of 15 plant characteristics measured, race A differs from B in 10 and from C in 8; races B and C differ in 9. The races were also characterized in terms of crossability and morphological comparisons with the parental species. It has been shown, then, that higher allopolyploidy may give rise to populations with novel aneuploid numbers, high fertility, and distinctive morphologies. (Research carried out at Brookhaven National Laboratory under the auspices of the U.S. Atomic Energy Commission.)

SMITH, JIMMIE B., and TETSUO MATSUI. Unusual Origin of a *Drosophila* Gynandromorph. *Botany Department, University of Hawaii, Honolulu, Hawaii.*

A bilateral gynandromorph was discovered in *Drosophila* among the progeny of a cross between a balanced lethal female of genotype $\frac{\text{Bl} \quad +}{+ \quad \text{Cy}}$ and a male homozygous for the recessive, hairy. The fly was a typical sexual mosaic such as are presumed to arise by X chromosome elimination in an early cleavage division. However, this fly was also bilaterally mosaic for the two dominants of the balanced lethal parent, which are located on the second autosome. The Bl (short bristle) trait was associated with the left or male side of the fly, the Cy (curly wing) trait with the right or female side of the fly. Mosaicism for both sex-linked and autosomal traits almost certainly means that this fly resulted from a simultaneous fertilization of a binucleate egg with unlike sperm. That silkworm mosaics arise in this way has been ingeniously demonstrated, but only four such cases have been reported for *Drosophila.* Of the four, this fly seems most clearly to prove that gynandromorphs in the fruit fly can arise by other means than by X-chromosome elimination, contrary to the impression given by most texts on genetics.

SMITH, LOIS J. *See* RUSSELL, ELIZABETH S.

SMITH, S. G. *See* MANNA, G. K.

SMITHIES, OLIVER. The Serum β-globulin System in Humans. *Connaught Medical Research Laboratories, University of Toronto, Toronto, Canada.*

Two well-recognized examples of polymorphism in human proteins (the serum haptoglobins and some serum γ-globulins) appear neither to be associated with red cell blood groups nor to lead to metabolic abnormalities. The involvement of genetic factors in the control of both these systems has been established (Smithies and Walker, 1955 and 1956; Grubb, 1956). The present paper summarizes the evidence for a further comparable example of protein polymorphism in human serum β-globulins.

The presence of a previously unrecognized β-globulin D was demonstrated by two-dimensional starch-gel electrophoresis (Smithies, 1957) in the sera of 2 New York negroes (49 tested) and 5 Australian aborigines (23 tested). In the sera of several hundred Canadians previously examined β-globulin D was not observed and β-globulin C was quantitatively the predominant β-globulin. Sera from more Australian aborgines and their families have been studied and a third β-globulin type has been observed in which β-globulin D is present, but β-globulin C is essentially absent. The results of these studies suggest that the presence or absence of β-globulins C and D in the serum is controlled by 2 autosomal alleles (β^C and β^D) with no dominance (Horsfall and Smithies, 1958).

Evidence has also been obtained for a third allele (β^B) at the β-globulin locus in whites (Smithies, 1958). Protein patterns in which β-globulins B and C are present in apparently equal amounts have been seen with sera from 5 donors (425 tested) at the blood bank of the Toronto General Hospital. (In the usual patterns β-globulin C is present in much greater amounts than β-globulin B.) Family studies suggest that these 5 persons are heterozygous for the genes β^B and β^C.

No correlation between the β-globulin types and the ABO, Rh, MNS, P, Kell, Duffy and Lewis blood groups has been observed.

SNELL, GEORGE D. Histocompatibility Genes in the Mouse. *Roscoe B. Jackson Memorial Laboratory, Bar Harbor, Maine, U.S.A.*

This exhibit shows how individual histocompatibility genes in the mouse have been identified. Several techniques are illustrated. The use of tumor cell suspensions prepared in the cytosieve permits the administration of a controlled dose. Mice are easily immunized with a cell suspension of thymus from the tumor donor. These two techniques make possible the demonstration of "weak" histocompatibility differences with transplantable tumors, which otherwise sometimes respond only to "strong" differences between donor and host. The most valuable genetic techniques are based on the use of coisogenic strain pairs (CSPS), i.e., strain pairs essentially identical except for a difference at a single histocompatibility locus. A chart shows how these are produced.

Three histocompatibility (H) loci are now known. *H-1*, in the first linkage group, shows about 7.1% crossing over with albinism. It may be that the *H-1* antigen is absent in skin, since skin grafts (Dr. Stevens) take successfully between members of a CSP differing at *H1*. Though "weaker" than *H-2*, *H-1* imposes a fairly effective barrier to the transplantation of leukemias. *H-2* was first identified by Dr. Gorer as a blood group locus. It plays a dominant role in all histocompatibility phenomena in the mouse. At least 16 alleles are now known, each of which determines a group of (8 or more) antigenic factors or components. Crossing over between the components has been demonstrated independently by Drs. Gorer and Allen. *H-2* is thus actually a system of pseudoalleles. It is in linkage group IX about 5 units from *Fu* (Allen). *H-3* is in linkage group V, about 9.8 units from *a* (this estimate may be high). Though probably a less complex system than *H-2*, there is already evidence for 4 alleles. Skin grafts between members of a CSP differing at *H-3* survive about 3-4 weeks as compared to 8-10 days for strain pairs differing at *H-2*.

SOBELS, F. H. Rates of Forward and Reverse Mutation Induced by Mustard Gas in *Drosophila*. *Institute of Genetics, State University, Utrecht, Netherlands.*

A study on the frequency of reversion of the mutant forked^{3n} of *Drosophila* after treatment with mustard gas was combined with tests for recessive visible mutations by using Muller's "Maxy" stock. Treated cv f^{3n} males were mated during four days to y ac pn w rb cm ct^{6} sn^{3} oc ras^{2} v dy g^{2} f od car sw /y sc^{S1} B f In 49 v females. Daughters suspected of carrying a mutation for one of the marker genes in the paternal X-chromosome were subjected to further genetic tests. The over-all mutagenic effectiveness of the mustard dose was measured for each experiment separately by sex-linked lethal tests. The weighted mean frequency of sex-linked lethals for 6 experiments under consideration is 11.2% ($n = 3{,}777$). After 5,000 r X-irradiation the same stock yielded 13.7% ($n = 2{,}252$) lethals. The genetic effects of the mustard dose used therefore correspond roughly to that of 4,000–4,500 r X-rays. In a total of 16,432 gametes the following numbers of male viable and fertile mutations were obtained: 7 ruby, 6 white, 5 garnet, 3 carmine, 2 prune, 2 singed. In 33,098 gametes 3 yellow, 3 vermilion and 7 reversions (5 complete, 2 partial) of f^{3n} to wild type were scored. Four eye color mutations (3 rb and 1 g) were isolated from females with mosaic gonads, indicating delayed effect of the mutagenic treatment. Out of 7 forked reversions 3 were likewise characterized by delayed appearance. All reversions segregate in crosses as sex-linked dominants. Tests to determine whether closely-linked dominant suppressors are involved are not yet completed. The spontaneous rate of back mutation of f^{3n} is according to Green (1958) 1/20,000. After 4,000 r X-rays Green (unpublished) obtained 38 f+ in 115,774 chromosomes and after gamma irradiation from Co^{60} 10 f+ in 65,206 chromosomes. It would seem so far that the rate of reversion induced by mustard gas falls in the same range as that produced by ionizing irradiation. The material for recessive visibles is still too small for any definite conclusion. With the possible exception of the ruby and white loci where Valencia and Muller (1949) reported 1/8,000 after 4,000 r X-rays, a comparison with their X-ray data does not suggest an entirely different response to the action of mustard gas. Because of delayed effects, comparisons of the mutagenic effectiveness of mustard gas with that of X-irradiation inevitably involve an underestimate for the chemical.

I want to express my appreciation to Dr. M. M. Green for the use of his unpublished data, and to Dr. I. I. Oster for supplying me with some of the stocks. This work was supported by the Health Research Council T.N.O.

(G. J. O. Jansen, J. Ringelberg and S. C. M. Schouten collaborated on parts of this project.)

SOKAL, ROBERT R. Selection for Differences in Pupation Site of *Drosophila melanogaster*. *Department of Entomology, University of Kansas, Lawrence, Kan., U.S.A.*

Drosophila melanogaster reared under controlled conditions in 6 dram shell vials containing cornmeal-molasses-agar medium will pupate at various places from the center of the medium surface to positions on the wall of the vial above the medium. Pupation site was observed in vials into which 10 eggs had been placed and from which optimally 10 pupae resulted. Since there was varying mortality of eggs and larvae and it was found that increased density lowered the percentage of peripheral pupation, pupation site readings had to be corrected for a constant density.

Mass selection (on a combined individual-family merit basis) for differences in pupation site resulted in a peripherally pupating (PP) and a centrally pupating (CP) line. Response of the two lines was asymmetrical. The PP line responded immediately and strikingly with a plateau reached and maintained by generation 15, while the CP line reacted only gradually and not by very much. At generation 18 a maximum difference was attained when the PP line had 100% peripheral pupae while the CP line had only 6% such pupae. The differences declined somewhat during periods of relaxed selection but were quickly re-established when selection was renewed.

Fertility and fecundity declined during selection, but recovered when it was relaxed. The 2 lines were examined for differences in: length of larval period, sex ratio, resistance of larvae to DDT in the medium, and 14 morphological characters. Appreciable differences were found in all but the first two.

Considerable statistical analysis has been performed in the interpretation of these data. The character as measured in percentages did not lend itself to satisfactory analysis and had to be transformed to a probit scale. An analysis of variance and covariance components for various generations of selection was undertaken in order to separate genetic and environmental effects. Fluctuations were observed in the expression of the character which appear to be due to unaccountable environmental variations. A number of analytical methods for dealing with such a situation are discussed.

Crosses and chromosome assays demonstrated that pupation site is a multifactorial character and have permitted estimates of the contributions of the various chromosomes to the expression of the phenotype. Evidence is presented that selection in the two opposite directions has affected different genic systems.

(Studies were aided by contract with Office of Naval Research Nonr. 171 (00).)

Sokolovskaja, I. I. Metabolic Changes in the Fertilization Action of Domestic Mammals. *All-Union Institute of Animal Breeding, Moscow, U.S.S.R.*

Fertilization, in the broad sense, is a complex of physiological actions, which includes gametogenesis, sexual reflexes, insemination, and the proper fertilization or the union of gametes.

There is a unity of the specific metabolic action of fertilization and the general physiological reactions in organisms (oxidizing-reducing actions, the changes of colloidal conditions, selective processes, the changes of O_2 uptake, and so on). The investigation of the role in fertilization of some glucoproteins and the ferments which act on them initiates the study of albumen metabolism in fertilization.

The presence of hyaluronic acid was established in the zona pellucida of ova, in viscous matter of granulosa, and in the seminiferous tubules of testicles (in the Certoly simplast). After spermatozoa enter the zona pellucida, changes in the uptake of hyaluronic acid were observed. Histochemical and ferment reactions (mucicarmin, hexamethylen–tetramin silver complex, the ferment action on the zygotes) as well as the behaviour of radioactive sulfur (S^{35}), being included in organic matters (tiamin, cystin and others), show the presence of mucins in the zygote's zona pellucida and protective layer (which is formed in the oviduct), in the secretion of cervix of the uterus of some mammals and Cooper glands of hogs. The protective layer of the zygote consists of mucin and the source of this layer is a secretion of the oviduct's cells. In the uterus secretion of cows and sows and in the secretion of the rabbit's prostatic gland the ferment mucinase was found. This ferment provides specific changes of the colloid's conditions of mucins, in particular, the mucins of the cervical secretion of cows and ewes.

The richest source of the mucinase in nature is the prostatic gland's secretion in rabbits.

Mucinase is thermolabile. Dried at room temperature it does not lose its potency for years.

The addition of mucinase to the synthetic medium for semen (0.25 mg. per one cow) facilitates the spermatozoon's advance to the site of fertilization and so increases the possibilities of impregnation by 15% on the average.

Solima, Angela. *See* Nicoletti, Benedetto.

Sparrow, Arnold H. *See* Cuany, Robert L., *et al.*

Spiess, Eliot B. Relation between Karyotype Components of a Population and Adaptive Values of Gene Arrangements in *Drosophila persimilis. Department of Biological Sciences, University of Pittsburgh, Pittsburgh, Pa., U.S.A.*

It has been demonstrated (Spiess, 1957) that the karyotype combinations of chromosome III gene arrangements (*D. persimilis*), Klamath and Mendocino, which are rare in the wild habitat sampled, are approximately equal in adaptive value when competing together under laboratory conditions at 16°C. When the commonest arrangement (Whitney) competes with either KL or MD, on the other hand, frequencies of WT-KL or WT-MD come to stable equilibrium. WT *vs.* KL gives $\hat{q} = 25\%$ KL and WT *vs.* MD gives $\hat{q} = 37\%$ MD approximately. Six experimental populations containing all three arrangements come to stable equilibrium after seven to ten generations at approximately 78% WT, 8% KL, and 14% MD. MD is higher than KL in all but one population at equilibrium, by 7–10%. These data corroborate the evidence obtained from two-arrangement populations that interaction of the WT arrangement brings about a constant inequality between KL/KL and MD/MD; and the order of relative superiority for karyotypes in three-arrangement populations agrees with that expected from the WT two-arrangement experiments. (This work has been done under Contract No. AT–(30–1)–1775 with the United States Atomic Energy Commission.)

SPOFFORD, JANICE B. Parental Control of Position-Effect Variegation. *Department of Zoology, University of Chicago, Chicago, Ill., U.S.A.*

The extent of variegation of eye pigmentation in male *Drosophila melanogaster* was found to depend not only on the genotype of the affected fly but on the genotypes of his parents. Variegation resulted from an insertion (*Dp* (w^+)) of a small region of the X chromosome including the w^+ locus into the centromeric heterochromatin of 3L. The X chromosome carried *w*. Various Y chromosome fragments were present singly in individual flies. The experimental flies were derived from crosses between stocks whose X, second and normal third chromosomes were rendered reasonably co-isogenic by use of the Muller-5; *Cy*; *Ubx/Xa* technique. Extent of variegation was estimated visually for both eyes of each fly and was measured photoflurometrically on two spots separated chromotographically from each head. When the w^+-bearing third chromosome in the sons was derived from a mother homozygous for it, the pigmentation in some of these males was 90 times as great as when the *Dp* (w^+) came from a heterozygous mother. This effect is more pronounced in the presence of certain Y fragments than of others. Whether the sex of a heterozygous parent contributing the duplication or the sex of the parent contributing the Y has an important influence on the extent of variegation in sons was also studied. Only a complex causal mechanism responsible for position-effect variegation at the w^+ locus could account for pre-fertilization influence of maternal genotype on an essentially biochemical trait developed late in pupation.

SPOFFORD, JANICE B. *See* BAKER, WILLIAM K.

SPRAGUE, LUCIAN M. The Inheritance of a Natural Antibody in Cattle. *U.S. Bureau of Commercial Fisheries* and *Scripps Institute of Oceanography, La Jolla, Calif., U.S.A.*

Natural antibodies are portions of the normal globulin moiety of the sera of many species of animals and have been recognized by serologists for over seventy-five years. Some of these fractions are recognized by their reaction with the red blood corpuscles of the same or different species. Students interested in the origin of natural antibodies disagree as to whether natural antibodies are fundamentally a normal physiological property of the individual or species and therefore subject to genetic control or whether natural antibodies are immune responses to a generally similar environment and are therefore subject essentially to external environmental origins.

The discovery of a relatively rare antibody in the normal serum of cattle by Stormont (1951) and the pattern of its occurrence suggested that it might be subject to genetic control. This antibody is designated normal cattle anti-sheep O and referred to simply as anti-O. Since its discovery, 128 cattle have been recorded as containing demonstrable anti-O fractions in their sera. The pattern of the occurrence of anti-O antibodies is compatible with the hypothesis that anti-O is the product of a single dominant gene.

Two other properties influence the phenotypic expression of animals carrying the gene for anti-O. These two properties are the two soluble blood group substances found in the serum of some cattle. One of these described by Sprague (1957) has been designated Oc or cattle O substance. The other is cattle J substance described by Stormont (1949).

Anti-O is not detectable in the serum of cattle in which either or both of the J and/or Oc substances can be found. J-positive and/or Oc-positive animals may have J-negative, Oc-negative, anti-O offspring. The anti-O gene may therefore be regarded as an hypostatic dominant with regular autosomal segregation.

SRB, ADRIAN M. Different Expressions of a Nuclear Gene in Combination with Different *Neurospora* Cytoplasms. *Department of Plant Breeding, Cornell University, Ithaca, N.Y., U.S.A.*

A spontaneous mutant of *Neurospora sitophila* has an aconidial phenotype. When the mutant culture is crossed reciprocally with wild-type *N. sitophila*, the segregation pattern in either progeny indicates the aconidial characteristic to be based on a simple allelic difference from the wild type. The results are quite different when the aconidial *N. sitophila* is reciprocally crossed with a stock of *Neurospora* whose nuclear genome is essentially that of wild-type *N. sitophila,* but whose cytoplasm is SG-mutant cytoplasm from *N. crassa*. This latter stock has been obtained as the result of a series of nine back-crosses following an original interspecific cross where SG-*Neurospora crassa* was used as protoperithecial parent and *N. sitophila* was used as conidial parent. The back-cross series was such that *N. sitophila* was used as a recurrent conidial parent, while the protoperithecial parent was always an isolate from the preceding generation, carrying SG-*N. crassa* cytoplasm. When the reciprocal cross is made between the aconidial *N. sitophila* and the stock carrying an *N. sitophila* nuclear genome but SG-cytoplasm from *N. crassa*, the two progenies are as follows: (*a*) the progeny whose protoperithecial parent was aconidial *N. sitophila* show a one to one segregation for the aconidial characteristic; (*b*) the progeny whose protoperithecial parent carried SG-cytoplasm from *N. crassa* typically are all conidiating cultures. That the nuclear gene for aconidial is represented among this latter progeny is shown by crosses where progeny cultures are crossed back onto *N. sitophila* cytoplasm. About half of such crosses show segregation for aconidial. The results seem best explained on the basis of differential interaction between a particular nuclear gene and different cytoplasms.

STADLER, JANICE, and JOHN W. GOWEN. Implication of Genetics to Radiation Effects on Quantitative Characters. *Genetics Department, Iowa State College, Ames, Iowa, U.S.A.*

The quantitative characters, weight and growth, natural and acquired disease resistance, fertility, litter size and frequency, life span etc. are utilized in our laboratory to detect and evaluate effects of different types of radiation. The genetic variability of the mouse population is broken up into discrete units having reproducible characteristics through the use of some ten inbred lines, their crosses, F_2's and backcrosses. Under conditions of only natural irradiation, these lines have shown differences in all of the quantitative characteristics listed above. Each of these attributes, except acquired immunity, is affected by whole body irradiation of X-rays and gamma rays of cobalt 60. The irradiation effects are detrimental to the exposed individuals. They show genotype and irradiation dose dependence. The differences extend to body regions as well as to the body as a whole. In terms of the interactions between genotypes, irradiation treatments and regional body differentiations, the results indicate that the effects largely depend on the individual cells. The large decreases in resistance to mouse typhoid, *Salmonella typhimurium*, when all cells were exposed to irradiation, over those expected from the summed contributions of the individual parts supports the conclusion that all body cells retain most of their initial genetically controlled ability to resist disease invasion even when they differentiate into specialized tissues. (This work has received assistance from Contract No. AT(11–1)107 from the Atomic Energy Commission.)

STADLER, JANICE. *See* FUNG, SUI-TONG.

STAIGER, HANS R. The Chromosomal Structure of Hybrid Populations of *Thais lapillus. Mergenthaler Laboratory for Biology, The Johns Hopkins University, Baltimore, Md., U.S.A.*

Two ecologically differentiated forms with the haploid numbers 13 and 18 chromosomes occur in the intertidal snail species *Thais* (= *Purpura*) *lapillus*; their numerical chromosomal dimorphism is due to five structural changes of the "centric fusion" type. The two forms interbreed freely where they come into contact in adequate habitats, forming hybrid populations with all possible degrees of chromosomal heterogeneity. An analysis of individual relative frequencies of chromosomes in populations over the whole range of heterogeneity demonstrates a numerical differentiation between the 5 chromosomes involved, revealing a definite chromosomal organization of the hybrid populations. The frequency data on the 243 ($= 3^5$) chromosomal constitutions, which may be formed on the basis of the numerical dimorphism, contradict heterosis and balanced polymorphism as a mechanism for stabilization of the chromosomal polymorphism. The data suggest a stabilization mechanism on the basis of inter-chromosomal interaction which favors individuals with complete and intact sets of dimorphic chromosomes of either form, while individuals with both sets combined from chromosomes of different origin are adaptively inferior.

STALKER, HARRISON D. Sex Frequencies in *Drosophila paramelanica. Department of Zoology, Washington University, St. Louis, Missouri, U.S.A.*

An X-chromosomal, male-limited sex-ratio trait similar to those known in other Drosophila species has been found in *Drosophila paramelanica.* Males hemizygous for the "sex-ratio gene" produce almost entirely X-bearing sperm, and thus daughters and very few sons. Approximately half of the sons that are produced by such males are from nullo-XY sperm and are thus XO and sterile. All "sex-ratio" X-chromosomes analysed carry at least two short inversions in one arm and two in the other, and show little crossing-over with the normal X-chromosome in heterozygous females. Studies made so far indicate that there are at least two kinds of sex-ratio genes and at least two genetically different kinds of Y-chromosomes in nature. The "northern" sex-ratio gene SR^N is effective with the "northern" Y-chromosome Y^N, but is suppressed when in combination with the "southern" Y-chromosome Y^S. The "southern" sex-ratio gene SR^S is expressed when present with either Y^S or Y^N. No morphological differences have been discovered between the two kinds of Y-chromosomes. Although in general SR^S and Y^S are found in southern populations and SR^N and Y^N to the north, some southern populations, as in Missouri and Indiana, have mixtures of Y^S and Y^N. In addition to the possible suppression brought about by the *Y-SR* interactions, most populations, northern and southern, have autosomal factors which may modify or completely suppress the *SR* genes.

STEHR, G. On the Determination of Polymorphism by an X-Chromosomal-Autosomal Balance. *Forest Insect Laboratory, Sault Ste. Marie, Ontario, Canada.*

Results of studies on the spruce budworm, *Choristoneura fumiferana* (Lepidoptera), lead to the general hypothesis that sex-controlled polymorphism in either or both sexes is determined by a balance between X-chromosomal and autosomal heteroallelic loci, similar to the balance mechanism that determines sex itself. On this basis polymorphism is interpreted as genetically akin to intersexuality.

STEIN, WERNER. *See* LASKOWSKI, WOLFGANG.

STEINBERG, ARTHUR G. Blood Group Studies on an Isolated Human Population. *Western Reserve University, Cleveland, Ohio, U.S.A.*

This is a preliminary report of a religious sect, the Hutterites, living in the Dakotas and Montana in the United States, and in Manitoba, Alberta and Saskatchewan in Canada. The study is designed to be an intensive investigation of population genetics based on data collected during a detailed medical-genetic investigation of the Hutterites.

The data were drawn from 3 of approximately 100 communal colonies forming the sect. Each colony consists of 100 to 175 individuals living communally on a large farm (3,500 to 5,000 acres). In all 443 Hutterites in about 50 families, with 15 surnames among them, settled into 4 communal colonies in South Dakota. Of these 2 combined leaving 3 colonies, from which the present colonies are derived. Before 1900, another half-dozen Hutterite families joined the colonies. One new surname was added and one lost. Present-day Hutterites are all descendants of these people. The maximum sample of alleles at each locus in the population which gave rise to the present Hutterites is about 200 (50 families × 4); the minimum is about 32.

It is possible to trace the pedigree of every Hutterite who ever lived in a colony back to ancestors who settled in one of the original colonies in the United States.

When the population in a colony becomes too large, new land is purchased and a group of families is chosen by lot to develop the new farm. Clearly this method of selecting individuals for the new farm provides an excellent sample for studying genetic drift. The Hutterites are divided into three sub-sects, one derived from each of the original three surviving colonies. There is essentially no marriage between individuals from different sects, thus providing further opportunity for studying genetic drift.

The blood group data indicate large variation in blood group and blood type frequencies among the three colonies studied, which can be explained most simply on the basis of drift.

STEINER, ERICH. Some Observations on Incompatibility Alleles of the Complex-Heterozygotes of *Oenothera. Department of Botany, University of Michigan, Ann Arbor, Mich., U.S.A.*

Earlier studies have demonstrated the presence of incompatibility alleles in the alpha complexes (those transmitted through the egg) of the *biennis* group 1 of *Oenothera*. Evidence of incompatibility alleles in the alpha complexes of races belonging to other phylogenetic groups can be obtained by producing hybrids combining these alpha complexes with the alpha *biennis* group 1 complexes. Self-incompatibility of such hybrids indicates the presence of incompatibility alleles. A survey currently in progress shows that the alpha complexes of at least four phylogenetic groups of complex-heterozygotes in addition to the *biennis* group 1 possess incompatibility alleles. In the race *Heber* results indicate that the S allele may have undergone mutation to an S_f or self-fertile form, at least in one plant. The data which are available at present support in general the assumption that each race carries a different S allele, although critical tests of the identity of alleles in the different races have not been completed. Preliminary tests with self-incompatible alpha·alpha hybrids whose chromosome numbers have been doubled indicate that the incompatibility reaction in the tetraploid is the same as in the diploid.

STEINITZ-SEARS, LOTTI M. The Structure of Chromosomes in the Female Gametophyte of *Triticum vulgare. University of Missouri, Columbia, Mo., U.S.A.*

A stain squash method for the study of the embryo sac mother cell and female gametophyte (Darlington and LaCour, The Handling of Chromosomes, 1950) has been adapted to wheat. Under the dissecting microscope (× 90) after Feulgen staining *in toto*, a clear distinction can be seen between outer integuments (diploid), inner integuments (diploid) and female gametophyte (haploid). In agreement with studies by Golinski in 1893 it has been found that the antipodal cells divide at least three times in this species. Following the period of mitosis, they undergo a period of endomitotic divisions and growth until bundles of chromosomes, not unlike the salivary chromosomes of the Diptera, are found, but there is no fusion of centromeric regions into a common chromocenter or magma. As do salivaries, the antipodal cells eventually degenerate (similar data from other plants are given by Duncan and Ross, J. Hered. *41*: 259–268; Tschermak-Woess, Chromosoma *8*: 637–649).

The giant antipodal chromosomes of wheat are suitable for detailed studies of chromosome structures, such as heterochromatin, nucleolar organizing regions, centromeres and terminal chromosome sections. Megasporogenesis is being correlated with the developmental stages of the microspores in anthers of the same floret. As in other plants where megasporogenesis has been studied, it takes place later than microsporogenesis, approximately one week later in this species. Pachytene preparations are also being studied.

STERN, CURT. The Ratio of Monozygotic to Dizygotic Affected Twins and the Frequencies of Affected Twins in Unselected Data. *Department of Zoology, University of California, Berkeley, Calif., U.S.A.*

The significance of comparisons between the frequencies of monozygotic and dizygotic twins concordant for specific traits depends on the methods of ascertainment. With complete ascertainment in populations with twin material unselected except for the presence of a given trait, it has been assumed (1) that the ratio of monozygotic to dizygotic pairs is that of the general population, and (2) that the relative frequency of twins to singly born individuals is also like that in the general population. It will be shown that these assumptions are not valid.

Under the conditions stated (1) the ratio of ascertainable monozygotic to dizygotic twin pairs lies between one-half and one of the ratio in the general population, and (2) the ratio of all ascertainable twin pairs to the total number of individuals lies between one and two times of that found in the general population. Formulae will be derived which relate the frequencies of ascertainable twin pairs to the frequencies, from "suitable" parents, of the "affectable" genotype and to its penetrance. The calculated expectations will be compared with some observed values.

STERN, HERBERT, and T. S. FOSTER Some Intracellular Factors Governing DNA Duplication in Anthers of *Lilium longiflorium*. *Science Service, Canada Department of Agriculture, Ottawa, Canada.*

Chromosome duplication is associated in its primary stages with a pronounced shift in certain elementary metabolic processes of the cell. It will be shown that among such processes are those leading to the formation of low molecular weight deoxynucleosidic compounds. There is an obvious relation between the accumulation of soluble deoxynucleosidic substances and the subsequent synthesis of DNA in the sporogenous cells of the anther. A number of factors in the anther appear to be involved in this relationship. The possibility will be considered that the breakdown of tapetal cells furnishes DNA fragments which are used in later syntheses. The accumulation in the anther of the reducing compounds, glutathione and ascorbic acid, during periods of DNA synthesis, will also be discussed in terms of the genesis of deoxyribosides.

STEVENS, LEROY C. *See* BERNSTEIN, SELDON E.

STICH, H. F., and J. K. NAYLOR. Variation of the DNA, RNA and Protein Content of Specific Chromosome Regions during Development. *Department of Cancer Research, University of Saskatchewan, Saskatoon, Sask., Canada.*

Quantitative cytochemical studies of the basic mechanism of the "puffing" of particular chromosome regions, associated with chromosomal activity, were undertaken on the chromosomes of the salivary glands of the *Glyptotendipes* (Chironomidea) whose extraordinary size in an experimentally stretched condition enables the determination of DNA in single bands and in chromosome regions in which a puff is present or absent. The substances produced on the puffed regions were analyzed using cytochemical reactions for proteins, arginine and RNA.

Quantitative measurements made by the two-wave length method of Patau permitted the determination of the DNA (Feulgen) content of heterogeneous structures with less than 3% error. Similar measurements of chromosome regions treated with the Millon-reaction, the α-naphthol reagent (Leish and co-workers, 1957) and stained with fast green (Alfert and Geschwind, 1953) or azure B (Flax and Himes, 1952) yielded semiquantitative information on protein and RNA content. The metabolism of DNA and RNA also was studied by the autoradiographic method, using larvae which had been exposed to P^{32}.

Wide differences in DNA accumulation were found to occur following the formation of puffs in particular chromosomal regions. In one region, the DNA content consistently remained unaltered, while in a neighbouring one an 8–10 fold increase in DNA regularly followed. Moreover, this marked local accumulation was followed by a gradual diminution in the course of subsequent development.

The results also indicate differences between specific puffed regions in capacity to synthesize proteins and RNA. On some of these, basic proteins and RNA increased by more than 30-fold during the formation of the puff, whereas in others, primarily non-basic proteins appeared, but with no cytochemically detectable RNA. Certain puffed regions show a very high incorporation and rapid turnover rate of RNA, whereas in other puffs it is relatively very low.

It can be concluded that (1) the DNA content at a few, particular chromosomal regions is subject to variation, which shows that the DNA-content is not absolutely constant per chromosome set; (2) puffed regions produce substances of different chemical composition and metabolism, which might be considered as primary gene products; and (3) DNA variation occurs independently in different loci during the development, probably reflecting a functional pattern.

STILES, KARL A. Reproduction in a Mongoloid Imbecile. *Zoology Department, Michigan State University, East Lansing, Mich., U.S.A.*

A woman who had been diagnosed as a mongoloid imbecile gave birth to a child that was also diagnosed as a mongoloid. The mother was 19 years old when the daughter was born. The daughter is illegitimate and the father is unknown. The daughter is unquestionably mongoloid; she has a mongoloid facial expression, thickened tongue, stubby fingers and toes, low rate basal metabolism, dry skin, cephalic index of 85, and dermatoglyphic records, which were analysed by Dr. Norma Ford Walker and shown to be definitely those of a mongoloid. Her I.Q. is 22, and she functions at a low imbecile level.

The mother's facial expression is not so definitely mongoloid as that of the daughter. Furthermore, her dermatoglyphic records, which were also analysed by Dr. Norma Ford Walker, placed her in the overlap area. Therefore, these dermatoglyphic records neither provide evidence for mongolism, nor do they give any proof that she is not a mongoloid.

The mother does have the following combination of mongoloid characteristics: basal metabolism low, skin dry, depressed nasal bridge, lax joint ligaments, thick broad tongue, cephalic index 84, almond-shaped eyes, stumpy hands and feet, and small round ears. Her I.Q., taken in 1952, was reported as 41 on a Stanford-Binet-Form L, and again in 1956 with the same test as 44.

This study supports the conclusion that a mongoloid child was born to a mongoloid mother.

STINSON, HARRY T., JR. Genome-Cytoplasmic Interactions and Species Crosses in Oenothera. *Connecticut Agricultural Experiment Station, New Haven, Conn., U.S.A.*

The circle-forming behavior of certain Oenothera strains makes it relatively easy to transfer the genome of one species into the cytoplasm of another. The procedure used was to cross a geographical race of the complex-heterozygous species *O. parviflora* as female by an alethal, complex-homozygous race of *O. hookeri*. The F_1 complex combination, alpha *parviflora*·^{h}*hookeri*, gives ⊙ 14 at meiosis. On selfing, ^{h}*hookeri* · ^{h}*hookeri* segregates are obtained in *parviflora* cytoplasm, since *parviflora* was female parent in the original cross. The recovered *hookeri* plants are only slightly different from the original *hookeri* parent, probably owing to *parviflora* genes which entered one, or both, of the recovered *hookeri* complexes through crossing-over. The recovered and original *hookeri* are further alike in their breeding behavior when used as male parents, but are markedly different when crossed as female parents by the same tester strains. *O. hookeri* crossed as female by *O. parviflora* and *O. argillicola* gives chlorotic F_1 plants which die as seedlings. In contrast, the recovered *hookeri* in *parviflora* cytoplasm gives fully green plants when crossed by the same parvifloras, and fully green and green-yellow variegated plants when crossed by the argillicolas. The variegated plants result probably from male transmission of *argillicola* plastids which are incompatible with the ^{h}*hookeri* · ^{h}*argillicola* genome. The recovery of ^{h}*argillicola* · ^{h}*argillicola* plants in *parviflora* cytoplasm is also possible by the method outlined above. When now the cross is made between *hookeri* and *argillicola*, both of which possess *parviflora* cytoplasm, all the progeny are fully green; no variegated plants occur. Thus, for the first time in the American Oenothera material it has been possible to get mature green plants with the genome combination ^{h}*hookeri* · ^{h}*argillicola*, by employing the cytoplasm (plastids) of a third species, *O. parviflora*. That the different breeding behavior of the recovered *hookeri* is not due to the presence of alpha *parviflora* genes acquired through crossing-over in F_1 (alpha *parviflora* · ^{h}*hookeri*) is indicated by the fact that ^{h}*hookeri* · ^{h}*hookeri* plants isolated from the same F_1 in *hookeri* cytoplasm breed as the original *hookeri*.

Stone, W. H., and M. R. Irwin. Blood Types of the Progeny of a Pair of Cattle Twins showing Erythrocyte Mosaicism. *Genetics Department, University of Wisconsin, Madison, Wis., U.S.A.*

The majority of twins in cattle are zoological chimeras in that they show mosaicism of the erythrocytes, and possibly of other tissues as well as the hematopoietic tissues. The report of erythrocyte mosaicism by Owen (Sci. *102*:400) stated that a twin sire had failed to transmit to any of twenty progeny certain of the antigenic factors of his blood, implying that these antigenic factors were present somatically but not germinally. Progeny from each of a pair of twin bulls with erythrocyte mosaicism have been tested for possible effects of the intimate union of the hematopoietic tissues on the germinal and somatic tissues of each twin. Each twin possessed in approximately equal proportions two antigenetically distinct kinds of blood cells. After differential hemolysis tests, the abbreviated blood types of the two kinds of cells were: type I: $QE_1'I'/BGKO_3A'$ C_1X_1 F/F J/- and type II: $QE_1'I'/BI_1$ C_1X_3 F/F J/- L/- Z/- H'/- representing respectively, four and seven of the ten antigenic systems of cattle blood. Seven progeny from testcross matings of one of the twins (genotype of type I) did not contain BI_1, L, Z, or H' which differentiate type II blood from type I. Similarly, 19 progeny of the co-twin (genotype of type II) did not possess the phenotype $BGKO_3A'$ or X_1 which differentiates type I bood from type II. The progeny of each twin sire possessed in expected proportions only those antigenic factors produced by the genes corresponding to the genotype of the sire. Thus, the intimate association, beginning in early embryonic life, of the two kinds of hematopoietic tissues in each twin did not demonstrably affect either the cellular antigens formed by these tissues, or the genes for the cellular antigens transmitted by each twin to its offspring.

Stone, W. H. *See* Bednekoff, A. G., *et al.*

Stormont, Clyde. *See* Rasmusen, Benjamin A., *et al.*

Strauss, Bernard S. Effect of the Distribution of Incorporated Sulfur on the Lethal Effect of Incorporated $S^{35}O_4$. *Department of Zoology, Syracuse University, Syracuse, N.Y., U.S.A.*

In order to study the effect of incorporated S^{35} under conditions of defined radiation dose $S^{35}O_4$ was incorporated into conidia of *Neurospora crassa*. Sulfate was incorporated at different specific activities; so the amount of sulfur incorporated into cysteine or methionine varied. A conidium containing enough S^{35} to give one d.p.m. accumulates a radiation dose from the sulfur of about 400 r per day.

A suspension of 10^7 spores/ml. will take up all the sulfur from a medium 1.8×10^{-5} molar with respect to sulfate in two hours incubation with aeration of 30°. The conidia increase their sulfur content by about 40% and increase in total nucleic acid and average number of nuclei per conidium. Addition of 3×10^{-2} micro mole of methionine per ml. practically prevents incorporation of S^{35} into methionine, but does not appreciably affect incorporation into protein cysteine. The radiation dose accumulated during the incorporation period is negligible.

Spores are washed, frozen and stored at —10° in small tubes. Frozen conidia not containing radioisotope die off on storage in the cold. The rate of death depends on the amount of sulfur (i.e., of germination) in the limiting incubation medium. After correcting for this difference in physiological state we have failed to demonstrate any differential effect on viability of sulfur distribution (ratio of S^{35} in protein cysteine/methionine) or of sulfur specific activity between 1.8 to 17 millicuries per micro mole. Our best measurements indicate a value for alpha in the inactivation relation $2.3 \log N/N_0 = -\alpha D$ (where D is the total number of disintegrations) of 1.1×10^{-5}. A dose of 73,000 r of chronic internal beta radiation is therefore required to inactivate 50% of a sample of incubated conidia compared to our previously reported 33,000 r for a single X-ray dose to non-incubated conidia. No transmutation effect is evident.

(Work supported under contract AT(30-1) 1138 between Syracuse University and the U.S. Atomic Energy Commission. The assistance of Dr. G. Failla with problems of dosimetry is gratefully acknowledged.)

STRÖMNAES, OISTEIN. Mutation Pattern in Two Wild-Type Stocks of *Drosophila melanogaster*. *Institute of Genetics, University of Oslo, Blindern, Norway.*

The mutation pattern has been investigated in two wild-type stocks of *Drosophila melanogaster*, one is Oslo, the other is Iso-Amherst. Males, 1 to 4 hours old, from the 2 stocks were treated with 1,800 r of X-rays, then mated individually to single females for 24 hours and transferred to new females every 24 hours for a period of 12 days. In testing for dominant lethals virgin hybrid females from a cross between cn bw; e^{11} ♀ × Canton-S ♂ were used; in testing for sex-linked lethals the Muller-5 technique was employed, and in the testing for 2-3 translocations a cn bw; e^{11} stock was used.

The daily brood pattern for dominant lethals for the two stocks shows up as similar curves. However, dominant lethal frequency is higher for Oslo stock than for Iso-Amherst stock in all first broods until the seventh brood where it is the same for both. From the eighth to the twelfth brood the situation is reversed: maximum frequency of dominant lethals for the Oslo stock appears in the sixth brood; for the Iso-Amherst stock in the eighth brood.

Tests for sex-linked lethals and 2-3 translocations were carried out only for sperms coming on the third, sixth, and eighth day after irradiation of the males. The data observed for 2-3 translocations are in good agreement with the data found for dominant lethals. Thus, the Oslo stock exhibits the highest frequency of translocations on the sixth day, while the Iso-Amherst stock has the highest frequency of translocations on the eighth day. The frequency of sex-linked lethals is higher in the Oslo stock than in the Iso-Amherst stock for all broods tested, and the highest frequency is found in the eighth brood for both stocks.

The observed data indicate an over-all higher mutation rate in the Oslo stock than in the Iso-Amherst stock. It seems reasonable to assume that the different mutability of the stocks has been achieved by selection during the evolution of the two stocks in order to make them better adapted to their natural environment.

(I wish to express my gratitude to the Norwegian Research Council for Science and the Humanities for financial support received.)

STROUN, J. H., L. R. STROUN-GUTTIERES, J. ROSSI, et M. STROUN. Modifications de la poule Leghorn traitée par de sang de pintade. *Laboratoire Rossi et Clinique Universitaire de Médecine Interne, Genève, Suisse.*

Les auteurs ont administré du sang de pintade à des poussins Leghorn jusqu'à la période de fécondation. Ils observent chez les Leghorn F_1 diverses modifications de leurs caractères dont ils discutent l'origine.

STROUN, M. *See* STROUN, J. H., *et al.*

STROUN, MAURICE. Hybridation végétative chez les plantes. *Institut Botanique de l'Université de Genève, Genève, Suisse.*

Les recherches poursuivies sur diverses plantes montrent que l'on peut modifier dans la génération traitée et dans la descendance les caractères d'une plante ne vivant en parasite sur une plante étrangère que pendant la période F_0.

STROUN-GOUTTIERES, L. R. *See* STROUN, J. H., *et al.*

STUTZ, HOWARD C. Penetrance-Dominance Relationships of a New Macromutation in Rye. *Botany Department, Brigham Young University, Provo, Utah, U.S.A.*

A mutant gene discovered recently in a strain of Turkish rye modifies a key taxonomic character in that mutant plants have several spikelets at each node of the spike. This mutant gene behaves as a simple recessive gene in crosses with annual strains of rye and as a dominant gene in crosses with perennial *Secale* species.

In segregating populations from hybrids with another strain of Turkish rye, mutant plants showed incomplete penetrance within culms in that only some nodes of the spike bore multiple spikelets. In an F_2 population derived from the hybrid with Merced rye (a spring annual variety) there was incomplete penetrance within culms, between culms, and apparently even between plants so that the mutant gene behaved as a sub-recessive. On some plants only a single node on a single spike of an entire plant expressed the mutant phenotype.

In segregating populations from hybrids with perennial species incomplete penetrance within culms but not between culms or between plants was expressed.

The penetrance and therefore the dominance of the gene thus appear to be less a property of the gene itself than a function of the external environment, as demonstrated by the variation of penetrance within and between culms of the same plant, and of the internal genetic environment as demonstrated by the variation of dominance from sub-recessive to complete dominance in different genetic strains. Furthermore, since the different genetic backgrounds are apparently new genetic environments for this particular gene, the dominance properties are apparently independent of any selective forces which several other workers (e.g., Fisher, 1931; Haldane, 1939; Wright, 1934) have suggested as the basis for the origin of dominance.

SUEOKA, NOBORU. Studies on the Genetics of Tyrosinase in *Neurospora. California Institute of Technology, Pasadena, Calif., U.S.A.*

A new variant form of tyrosinase in *Neurospora crassa* was obtained from a strain coming from Singapore. This form is different in both electrophoretic mobility and heat stability from other standard forms in our laboratory. Genetic analyses indicate that these differences are determined by the same locus (T-locus) which determines the other structural forms of tyrosinase in *N. crassa.* A second series of experiments is concerned with a strain which produces little or no tyrosinase or laccase (also a copper-containing phenolase). Crossing experiments previously showed that this inability to produce tyrosinase and laccase is controlled by a locus (designated *np*) independent of the T-locus. Heterokaryons of various combinations with regard to the different forms of tyrosinase and the inability to produce the enzyme have been made. It turns out that in the heterokaryotic state with producing strains, the nucleus carrying *np* now produces tyrosinase. For example, the heterokaryon (*np*, T^L) (+, T^S) produces a mixture of T^L (thermolabile) and T^S (thermostable) tyrosinases. This suggests that the normal allele of the *np* locus has some other function in the enzyme formation than the T-locus. Simultaneous blocking of laccase production supports this idea. Several other non-producing strains have been obtained from natural sources and these are being analyzed at present.

SUKHOV, K. S. Phases in Development of Phytopathogenic Viruses. *Institute of Genetics, Academy of Sciences of the USSR, Moscow, U.S.S.R.*

The developmental cycle of the tobacco mosaic virus within the host organism consists of qualitatively different phases. After completion of the reproduction phase, designated as the vegetative phase of development, the virus enters the resting phase. During the vegetative phase the virus diffuses throughout the tissues of infected plant but is unable to infect new plants through the conventional modes of inoculation, i.e., it lacks contagiosity. During this phase specific inclusions, the amorphous X-bodies, can be found in the cells. The vegetative virus is not precipitated by antiserum produced against the purified preparation of the resting virus. High temperature in the absence of light can prevent passage of the virus to the resting phase without inhibiting its reproduction. The virus blocked in this way transforms into the contagious form within 1½ to 2 hours after exposure of the infected tissues to optimal conditions.

The transformation of the vegetative virus into the resting rod-like form involves a transitory stage. During this stage, the elementary virus particles are represented by corpuscles with a peculiar morphology. In this state, the virus exhibits high but unstable contagiosity. The infectious corpuscles are precipitated by antiserum produced against the purified virus preparation isolated from mosaic leaves. The formation of rod-like particles with stable contagiosity is the terminal phase of the developmental cycle of the virus.

Experimental evidence shows that variability of the virus as caused by high temperature is to be related to the vegetative phase of development. The variability of the virus is directed and adequate to the acting factor.

SULKINOJA, MATTI. *See* VAARAMA, ANTERO.

SULLIVAN, ROBERT L. Sex Limitation of Several Loci in the Housefly. *Department of Entomology, University of Kansas, Lawrence, Kan., U.S.A.*

A strain of houseflies (*Musca domestica* L.) has been found in which the expression of the mutant brown body color is restricted to the female. When tested with a strain obtained from Dr. Milani of Pavia, Italy, in which brown body behaves as an autosomal recessive the following results were obtained. The American brown female crossed to an Italian brown male yields all brown flies in the F_1 and subsequent generations. When the normal male of the American strain is crossed to the Italian brown female the males are normal and the females brown bodied in the F_1 and subsequent generations. When the American brown female is outcrossed to a normal male the brown body color is expressed in one-quarter of the flies of both sexes in the F_2 generation.

The males of this strain when crossed with females of a green eye color strain give a similar result. In the F_2 generation green eye color is expressed only in the females. The brown and green loci have been found to be linked in other tests.

These results may be explained by several hypotheses which involve the attachment of a portion of a normal autosome to the Y-chromosome. This currently is being studied by further crosses and cytological examination.

(This investigation was supported by the Medical Research and Development Division of the Office of the Surgeon General, Department of the Army, Contract No. DA-49-007-MD-738.)

SUMPTION, LAVON J., and WILLIAM E. REMPEL. A Study of Evolution in Animal Breeding. *University of Nebraska, Lincoln, Neb., and University of Minnesota, Minneapolis, Minn., U.S.A.*

Animal breeding involves the study of methods of directing the forces of evolution in the improvement of the quantitative economic traits of farm livestock. Because of long generation intervals, limitations in population size and complicating effects of variable environmental conditions the interpretation of evolutionary change in farm animal populations is difficult. The annual rate of change is often indiscernible. A recent study with swine will illustrate how the forces of evolution are being applied to the general problem of animal improvement.

A new line of swine (Minnesota No. 3) was developed by combining 3 outbred breeds and 5 inbred lines: Gloucestershire Old Spot, Large White, Welsh, "C" Line inbred Poland China, Beltsville No. 2, San Pierre, Minnesota No. 1 and Minnesota No. 2. This was a deliberate attempt to increase the initial level of genetic variability as a means of augmenting effective selection within this population. This line was maintained as a single Mendelian population ranging in size from 220 to 490 animals, the progeny of from 9–12 sires and 37–62 dams per generation. Breeding and management practices were designed to capitalize upon natural selection for aggressive breeding ability among selected sires, maternal ability and early sexual maturity among selected dams.

During 6 generations, the performance of line has increased. There has been a significant positive shift in the frequency distribution of 56 and 140 day weights. No change in fertility or survival was evident. Wide variations in body type, color and other superficial traits were observed, factors that with critical analysis may be useful criteria as markers in measuring quantitative variability in animals.

Although genetic improvement of economic traits is slow the animal breeder can make significant progress in a working lifetime provided that: (1) projects begin with populations characterized by a high level of genetic variation, (2) the rate of inbreeding is low enough to provide for extensive recombination, (3) the population is large enough to generate new gene combinations in numbers, and (4) rigorous selection is practised with definite objectives.

SUOMALAINEN, ESKO. Polyploidy in Parthenogenetic Beetles. *Institute of Genetics, University of Helsinki, Helsinki, Finland.*

Of the 34 parthenogenetic weevil species and races studied cytologically, only one (*Polydrosus mollis* in Finland and Poland) is diploid (22 chromosomes), 23 are triploid (33 or 34 chromosomes), 8 are tetraploid (44 chromosomes) and 2 are pentaploid (55 chromosomes). Several of these weevil species are represented by a bisexual as well as by a parthenogenetic race. The former is always diploid, the latter generally polyploid. In addition to the diploid bisexual race, a weevil species may be represented by a number of parthenogenetic races, differing in their degree of polyploidy. The divergent races of a single weevil species have different distributions in all cases investigated so far. This is especially clear in some of the so-called boreo-alpine species. In the Eastern Alps this dissimilar distribution of the divergent weevil races appears to be definitely correlated with the various glacial conditions in different parts of the Alps. It is noteworthy that the relative proportion of parthenogenetic polyploid forms is considerably higher in Northern Europe (Fennoscandia) than, for instance, in Switzerland and in the Austrian Alps.

The chrysomelid beetle *Adoxus obscurus* is bisexual in America and parthenogenetic in Europe. The latter form of this beetle seems to be triploid.

SUOMALAINEN, HANNU O. T. Chromosomal Evolution in the Neuroptera. *Department of Zoology, The University, Turku, Finland.*

In the Neuroptera (lace-wings), representatives of 10 families have been studied cytologically. In general, the more ancient forms seem to have the highest chromosome numbers (up to $n = 13$). In two families at least, Myrmeleonidae and Hemerobiidae, whole arm transpositions (centric fusions) evidently have been the main cause of the decrease of chromosome number during evolution. Large "modern" genera seem to include mostly species with 6 to 8 pairs of metacentric chromosomes. In the Chrysopidae, another mechanism of chromosomal evolution apparently has set in. While the more primitive species possess 6 or 7 pairs of metacentrics, the more highly specialized ones have several acrocentrics in their set of $n = 6$. As has been shown earlier by the author, these insects have strictly localized distal chiasmata at least in the spermatogenesis. Thus, pericentric inversions have an increased chance of becoming established in the karyotype and probably have been responsible for the conversion of metacentrics into acrocentrics in phylogeny. Consideration of certain taxonomical features of the order Neuroptera gives additional support to the conclusion that genetic recombination is strictly delimited in certain families.

SUSKIND, SIGMUND R. The Role of Suppressor Genes in Controlling Tryptophan Synthetase Activity in *Neurospora crassa. The Johns Hopkins University, McCollum-Pratt Institute, Baltimore, Maryland, U.S.A.*

Yanofsky and Bonner have shown that specific suppressor genes are capable of partially restoring tryptophan synthetase activity in certain tryptophan-requiring (*td*) mutants of *Neurospora* lacking enzymatic activity. It was previously found that these suppressed mutant strains, which now form active enzyme, continue to synthesize an enzymatically inactive, antigenically related protein (CRM) characteristic of the unsuppressed mutant. Tryptophan synthetase has been prepared from inactive crude extracts of a temperature-sensitive *td* mutant (td_{24}) by fractionation and removal of an inorganic inhibitor. Such active preparations still contain considerable quantities of CRM in addition to the enzyme. The td_{24} enzyme exhibits high *in vitro* sensitivity to both the inhibitor and to zinc. Inhibitor and zinc sensitivity of partially purified enzyme preparations from the following strains have been compared: td_{24}, td_{24} Su_{24} (td_{24} carrying a specific suppressor gene) and wild type. Enzyme prepared from the suppressed mutant appears to resemble that of the unsuppressed td_{24} mutant, and not wild type. These preliminary results suggest that a suppressor gene may have little to do with the actual formation of the enzyme, but rather, it may serve a regulatory function, controlling inhibitor, cofactor or inducer levels or the extent of *in vivo* enzyme-inhibitor and enzyme-coenzyme complex formation. Such an interpretation may be favored by the recent observation that a pyridoxin mutant of *Neurospora*, grown on limiting pyridoxin, forms a protein antigenically related to tryptophan synthetase. Little if any enzyme activity can be demonstrated in crude extracts tested in the presence or absence of pyridoxal phosphate. The quantity of the inactive protein approximates the level of enzyme found in the wild type. Perhaps in coenzyme deficient cells, the apo-enzyme, instead of combining with coenzyme, reacts with a normal cell component, forming an inactive complex. Suppressor gene action will be discussed in light of these results.

SUTTON, H. ELDON. The Distribution of Haptoglobin Types and Their Genetic Implications. *Department of Human Genetics, University of Michigan, Ann Arbor, Mich., U.S.A.*

The frequencies of the three haptoglobin types have been determined in American whites, American Negroes, African Negroes (Liberia and Ivory Coast), American Indians (Apaches), and Asiatic Indians. The highest frequencies of the Hp^1 gene are found in the Negroes (0.80) and the lowest frequency in the Asiatic Indians (0.18). The frequencies for various tribes of the African group suggest intertribal differences. The possible relationship of these to past tribal history will be discussed. The existence of this balanced polymorphic system raises certain questions of selection favoring the heterozygous individuals.

SUYAMA, V. *See* MUNKRES, K. D.

SUYAMA, YOSHITAKA. *See* WOODWARD, VAL W., *et al.*

Suzuki, Kan-ichiro. *See* Tanaka, Yoshimaro, *et al.*

Suzuki, Yoshiko. *See* Rasmusen, Benjamin A., *et al.*

Sveshnikova, Irene. The Evolution of the Nucleus in the Genus *Vicia*. *Institute of Plant Physiology, USSR Academy of Sciences, Moscow, U.S.S.R.*

The karyological method applied by us in the systematics of the genus *Vicia* has revealed certain laws governing the evolution of that genus. Within the limits of minor taxonomic units, more precise correlative connections between these units can be discovered by the comparative study of changes in their systematic symptoms and in the morphological peculiarities of their nuclei. Given the existence of characteristic laws governing the translocation of interspecific hybrids, these translocations become indicators of the evolution of the species, thereby differing from the translocation of X-ray mutants. The X-ray mutants with surplus chromosomes obtained by us are also of interest in solving the problem of the phylogenesis of the species, since they help to study the localization of definite features in the chromosomes. Polyploid forms have been found only in perennial forms of *Vicia* reproducing from the root stalks, which points to the somatic origin of polyploids in the genus *Vicia*.

Swaminathan, M. S., and A. T. Natarajan. Cytological and Genetic Changes Induced by Vegetable Oils in *Triticum aestivum*. *Indian Agricultural Research Institute, New Delhi, India.*

Following our observation (Curr. Sci. *25*:382–4) that oils extracted from mustard (*Brassica campestris* var. *toria*), groundnut (*Arachis hypogaea*) and castor (*Ricinus communis*) are capable of inducing chromosome breakage in root tip cells of *Allium cepa* and *Triticum monococcum*, we soaked seeds of bread wheat (variety C–591) for 24 hours in each of these oils and planted them in the field. A study of mitosis in root meristems showed the occurrence of chromosome and chromatid breaks at metaphase and spindle abnormalities and "error" bridges presumably arising from sub-chromatid breaks, at the anaphase. Binucleate cells with both synchronised and non-synchronised mitosis were also seen. The presence of numerous fragments over several mitotic cycles suggested that exchange or reunion may be rare. However, at metaphase I of meiosis in microsporocytes, one to two quadrivalents were seen in several plants grown from seeds treated with groundnut, mustard and castor oils, indicating that delayed reunion may occur. Pachytene configurations gave evidence for the presence of deficiencies and duplications in the treated material.

Speltoids occurred among the treated plants both in the year of treatment and in subsequent generations. Two short and stiff strawed plants also occurred during the second generation in plants treated with groundnut oil. The variety C–591 is fully bearded and one plant in the material treated with groundnut oil was completely beardless. This plant was selfed and crossed with control C–591. Besides beardless plants, long-tipped, half-bearded and fully bearded plants also occurred in the progeny of the beardless plant. In the F_1 from C–591 beardless × bearded, fully bearded and long-tipped plants occurred in the ratio 1:1. The results are interpreted on the assumption that the original beardless plant should have been a chimaera with the germinal layer which gives rise to the glumes being homozygous for a deletion of the awn-producing genes and the layer giving rise to the micro- and mega-sporocytes being heterozygous for it. In the absence of dominant inhibitors, awn-producing alleles seem to show partial dominance. Thus, the present use of recessive symbols to designate awn-producing alleles by wheat geneticists appears to be incorrect.

Syrop, Harold W. *See* Hughes, Roscoe D.

Szende, K. An Unusual Mutation Frequency to Pentose Utilization in a Strain of *Ustilago maydis. Institute of Genetics, Budapest, Hungary.*

When monosporidial glucose-grown cells are spread on d-xylose agar, most of the cells form colonies, but not in a homogeneous manner as the colonies become visible between the third and fifteenth days. In liquid d-xylose medium the growth begins after a long lag. When washed cells were inoculated in a liquid medium without carbon source, there was a residual growth with a 10^2 size. This residual growth is not limited on agar without carbon source. The cells of the colonies picked from xylose plates and respread on xylose plates again showed no lag heterogeneity, perhaps owing to the selection of non-utilizers of xylose. After several passages on glucose media this xylose utilizing property remained stable. This indicates a mutational origin. A mutation rate higher than 10^{-3} was observed, but the examination of exact values encountered some difficulties because of the large residual growth, the high mutation frequency, and the unlimited growth on agar plates. As the mutational frequency is unusually high, thus making it difficult to obtain conclusive evidence for the discontinuous genic change, we cannot, therefore, exclude the possibility of a heterogeneous activation or inhibition of the formation of the xylose-utilizing enzyme complex resulting in a continuous change of the phenotypic expression. In the preliminary experiments the xylose isomerase activity was demonstrated in xylose adapted cells. After passage on glucose the cells lost their enzyme activity. It is possible that following the mutational event the presence of the xylose as a specific inductor is also necessary for the expression of the potency for formation of the xylose-utilizing enzyme complex.

Tabaczynski, Maciej. *See* Kunicki-Goldfinger, Wladyslaw.

Takahashi, Toshiaki. *See* Ikeda, Yonosuke.

Takasaki, Tsuneo. *See* Tanaka, Yoshimaro, *et al.*

TANAKA, KATUMI, and KOJI OHKURA. Evidence for Genetic Effects of Radiation in Offspring of Radiological Technicians. *Department of Human Genetics, Tokyo Medical and Dental University, Tokyo, Japan.*

In an attempt to study the genetic effects of radiation on man, from a list of about 5,000 radiological technicians registered with the Japanese Society of Radiological Technicians, 326 male technicians who had worked for 25 years or more in this field were selected for a study of reproductive history. A questionnaire was sent to all individuals and 750 male pharmacists who were used as controls. Both groups are very similar in economic, social, and educational levels in Japan. Answers were received from 255 technicians (78.2%) and 421 pharmacists (56.1%). However, only 232 of the questionnaires returned by technicians and 300 of those returned by pharmacists were complete and could be used in this study. The average age of technicians (53 years) was greater than that of pharmacists (48 years), but the average age when children were born was very similar (33.8 and 33.1 years). The mean year of birth for the offspring of technicians was 1937 and for those of pharmacists, 1943.

The frequency of sterility was significantly greater for marriages involving radiological technicians (13.80%) than those involving pharmacists (6.00%). The sex ratio of the offspring of technicians (55.25) and of pharmacists (52.59) are both higher than the average in Japan (51.24), but the difference between both groups is also significant ($p = .05–.02$). Frequencies of spontaneous stillbirth and abortion were found to be 6.31% in technicians and 3.54% in pharmacists. Difference between both groups seems to be significant ($p = .05–.02$) while both frequencies are close to the average in Japan. It should be kept in mind that the information on stillbirth and abortion may be incomplete because the events concerned happened about 15 years ago.

Average doses of irradiation are roughly estimated as at least 35 r per year, but the estimate is rather low.

TANAKA, M. *See* KIHARA, H.

TANAKA, NOBUNORI. Cytological Effect of Radioactive Rainfall. *Botanical Institute, Faculty of Science, University of Tokyo, Tokyo, Japan.*

Frequencies of chromosomal aberrations observed in mitotic cells (RTC) of *Tradescantia paludosa* of two experimental lots, one kept under glass and the other left in the open air, were studied in parallel. Experiment has been carried out solely in the rainy season which in Japan lasts about one month, usually around June. Temperature in this season is generally about 20°C.

Radioactivity of the rain was estimated by the radioactivity reduced to the value at 6 hours and 72 hours after the rainfall began, by extrapolation of the decay curve calculated on a sample collected at a fixed time daily and on that taken from the fixed-volume collection of rain water. Radioactivity of falling dusts in the air measured by means of the basin method has been proved to be negligible in the rainy season in Tokyo. Background radioactivity in the air in Tokyo usually stands around 25 cpm.

It seems very likely that differences in the frequencies of the chromosomal aberrations between the two lots are statistically significant, and that the frequency of aberration increases linearly as cpm/m^2 increases. Accumulated maximum dose of radioactivity for 26 days' exposure was 1.7×10^5 cpm/m^2, and regression equation resulted in $Y = 6.73 + 0.67X$, where X is 10^3 cpm/m^2 and Y, the frequency of aberrations per 10^4 cells.

Daily measurement of radioactivity of rain has been carried out by Drs. Takii, Kadokawa and Fukuda of the Central Meteorological Observatory, Tokyo, to whom thanks are due.

TANAKA, YOSHIMARO, KAN-ICHIRO SUZUKI, and TSUNEO TAKASAKI. Unlimited Progress by Selection in Inbred Lines of the Silkworm. *National Institute of Genetics, Misima, Sizuoka-ken,* and *Kumamoto Branch, Sericultural Experiment Station, Kumamoto, Japan.*

A European, a Chinese, and several Japanese races of the domestic silkworm, *Bombyx mori*, without crossing with other races or strains, were submitted to selection to increase cocoon-shell (silken layer) weight and its percentage to the total cocoon weight, two of the most important characters in sericulture.

The European race, *Giallo Ascoli*, and the Chinese race, *Giallo Oro Chinese*, both univoltines, were imported to Japan from Italy in 1926, and have remained under our control since 1927. The Japanese races were all bivoltines. The univoltines were raised once every year, in spring, the best season for silkworm culture; the bivoltines were reared twice a year, in spring and in summer.

Combined family and individual selections were carried out. For reproduction, inter-family matings were usually preferred to sib matings. Selection experiments on *Giallo Ascoli*, or 010 and *Giallo Oro* Chinese or 610 are still in progress, both attaining the thirtieth generation of inbred selection. The results are unexpectedly far-reaching. In 010, the single cocoon-shell weight which was around 38 cg. in the initial stock advanced to 88 cg. in 1936, 89 cg. in 1953, 90 cg. in 1955, and 97 cg. in 1956. These weights are, so far as I am aware, the highest ever achieved, and there is no sign of stopping the increase as yet. The percentage of cocoon-shell weight to the total cocoon weight has also strikingly gone up during the experiments. The size of larva and cocoon increased markedly, the texture of cocoon surface turned rough, and many other differences from the original stock were observed. No one would now recognize *Giallo Ascoli* in 010, although the latter was raised from the former only by inbreeding and selection. Similar results have been obtained with the Chinese race 610.

Theoretical analysis of these results is not easy. However, the authors are inclined to consider that instability or mutability of genes is concerned with the development of the characters investigated.

Selection in Japanese bivoltines proved, on the other hand, ineffective, partly owing to the fact that mortality in summer culture is usually much higher than in spring culture, thus discarding élite homozygotes which survived the spring culture, and leaving heterozygotes only for reproduction.

TANTAWY, ABDELAZIM OSMAN. Selection Limits with Sib-matings in *Drosophila melanogaster*. *Faculty of Agriculture, University of Alexandria, Egypt.*

Drosophila melanogaster were inbred by brother × sister mating to almost 100% coefficient of inbreeding. Selection for long or short wing length is effective to the fourth generation of selection (59.4% coefficient of inbreeding) in the high lines which show 1.0–1.5% deviation from the controls. Selection in the low line is more effective and continues until the fifth generation (67.2% inbred), when these lines show 5.0–6.0% deviation from the control level. Response to selection is ineffective at higher levels of inbreeding in both lines.

Phenotypic variation has been reduced by inbreeding and selection; short wing lines are less variable than long wing ones. The coefficients of variability decline in the earlier generations of selection and then stabilize. Selection was relaxed at 25%, 78%, 88%, and 99% of inbreeding, and the results indicate that relaxed selection, at lower levels, causes the variation to increase to the same level as in the controls, but at higher levels of inbreeding the relaxation of selection has no effect on the variability of the selected lines.

Heritability of wing length was calculated at the previously given coefficients of inbreeding before and after relaxation of selection. Intensive systems of inbreeding before and after relaxation of selection have no effect on the genetic variability at the lower levels of inbreeding (25%), but at higher levels of inbreeding the heritability estimates decline to almost the theoretical expectation. When selection was relaxed for five successive generations, the heritability estimates remained almost constant for the higher levels of inbreeding.

Much improvement for the character concerned is possible under selection with sib-matings before one would expect to approach homozygosity for the specific combining ability genes for wing length.

TANTAWY, A. O. *See* MALLAH, G. S.

TARNASKI, I. *See* PRIADCENU, AL., *et al.*

TASHIAN, RICHARD E. The Role of Enzyme Adaptation in the Heritability of Variation in D-phenylalanine Utilization in Man. *Department of Human Genetics, University of Michigan, Ann Arbor, Mich., U.S.A.*

There is evidence that the normal variation in the ability to utilize the D-isomer of phenylalanine may be to some extent under genetic control. If the availability of D-amino acid oxidase is the limiting factor underlying this variation, then it is essential that the normal variation in this metabolic step be established. The urinary excretion of D-phenylalanine and its corresponding alpha-keto acid analog (phenylpyruvate) after the oral administration of D-phenylalanine were used as a measure of D-isomer utilization and enzyme induction. Repeated administration of the D-phenylalanine substrate resulted, in some cases, in an increased conversion of the amino acid to the keto acid. This apparent induction of D-amino acid oxidase in the kidney and the possible heritability of this variation in phenotypic adaptation will be discussed.

TAUBENECK, UDO. *See* BÖHME, HELMUT.

TAVCAR, A. Genetics and Cytogenetics of Maize with Multiple Number of Leaves and Ears on Stalk Knots and Branches on Tassel Knots. *Institute of Plant-Breeding and Genetics, Faculty of Agriculture, Zagreb, Yugoslavia.*

In the year 1927 in the F_2 generation of a cross of two normal genotypes, one plant of maize developed with leaves on each stalk knot in a decussate position and ears on the middle stalk knots, as well as branches on each tassel knot. By selfing over a period of many years, some plants were raised with the following number of leaves on each stalk knot, ears on the middle stalk knots and branches on each tassel knot: (*a*) 1 (normal), (*b*) 2 (decussate), (*c*) 3 (triple), (*d*) 4 (quadruple) and (*e*) 6 (six). Beside these abnormal plants some others have developed on which the number of leaves on knots, and in connection with them also the number of ears on middle stalk knots and branches on tassel knots, are as follows (the first figure indicates the number of leaves on top knots of the plant, the others give the number of leaves on knots below): (*f*) 1:2, (*g*) 2:1, (*h*) 1:2:1, (*i*) 2:3:1, (*k*) 2:3, (*l*) 2:4, (*m*) 6:3, (*n*) 3:6 and (*o*) 1:2:3:1. On some plants with 2,3,4, and 6 leaves on each stalk knot, the tillers have had normal position of the mentioned organs. On such plants, genetic and chromosomic differences have been observed. With the increase in the number of the leaves per stalk knot, there has been a proportional decrease in the height of the plants and the length and breadth of the leaves. Through backcross of the abnormal plants with 2,3,4 and 6 leaves on each stalk knot to normals it could be shown that the dominance occurs in the following order: normal — 1 leaf (In) → decussate → 2 leaves (In^d) → 3 leaves (In^t) → 4 leaves (In^q) → 6 leaves (In^s). The genes for the mentioned character are multiple allelomorphic. The number of the leaves on each stalk knot, the number of ears on the middle stalk knots, and the number of branches on each tassel knot are in correlation.

The cytologic investigations have been made on sporocytes in different stages of meiosis. The normal plant, from which the abnormals have been raised, has had $n = 10$ chromosomes. In the abnormal plants the number and the structure of the chromosomes are different from the normal plants. The nearly homozygous abnormal plants have $n = 12–14$ chromosomes (11–12 bivalents and 3–2 univalents).

In meiosis of the abnormal plants many disturbances appeared in the form of bridges, translocations, splittings of chromosomes, etc.

TAYLOR, J. H. *See* WOODS, PHILIP S.

TAYLOR, LEWIS W. Further Studies on Diplopodia IV: Breeding Performance of a Presumably Homozygous Diplopod Male. *Department of Poultry Husbandry, University of California, Berkeley, Calif., U.S.A.*

Diplopodia in White Leghorn chickens is a simple recessive, almost always lethal character (Taylor and Gunns, J. Hered. *38*:66). In fifteen years, only one female and two males exhibiting weak expressions of diplopodia have been reared to maturity. The female laid two shell-less eggs before death; one male produced no semen, the other (P122) was mated by artificial insemination to two lines of diplopod carrier females significantly differing in phenotypic segregation ratios (Taylor, Abbott and Gunns; Abbott, J. Genetics, in press).

With dams from the line segregating in a 3:1 ratio, P122 produced 22 normal :32

diplopod embryos (59.3% diplopods). With the line usually producing less than 6% diplopods, he sired 67 normal :16 diplopod embryos (19.4%). Of 25 normal offspring hatched from these matings, 20 were reared to maturity. One male died before mating and one female was infertile; the remaining 9 males and 9 females all proved in test matings to be heterozygous carriers of the diplopod gene. P122, therefore, meets the criteria for homozygosity of the diplopod gene.

Diplopodia was expressed in P122 by the presence of a single supernumerary toe on one foot. That such an attenuated expression might represent high penetrance of the gene in heterozygous state finds no support from the above data. Furthermore, phenotypic segregation ratios from this male depended on the line of origin of his mates. Additional confirmation of the importance of the genetic constitution for genes other than the diplopod gene in modifying the incidence of diplopodia is derived from these matings. The superior viability and reproductive performance of this diplopod male may be related to the fact that he originated in the third generation following an outcross of two diplopod lines to a non-related inbred strain of White Leghorns.

Taylor, St. Clair S. A Linear Growth Process in Twin Cattle. *A.R.C. Animal Breeding Research Organisation, Edinburgh, Scotland.*

Experimental herds of monozygous and dizygous twin cattle belonging to the Animal Breeding Research Organisation have provided a slow motion picture, so to speak, of growth and development.

The rates of emergence of differences in size between twin and co-twin have been studied. A comparison of these rates in the two types of twin indicates the pattern of emergence of genetic differences.

Complementary to rates of emergence of differences in size are their persistence or degree of permanence. Results on that aspect of variation are interpreted in terms of the relative efficiency of selection for growth at various ages. For example, of the variation present between dizygous twins at 2 years of age about one-third appeared between the ages of 9 and 12 months; whereas monozygous twins showed no corresponding increase in variation. Since these dizygous differences emerging between 9 and 12 months of age also show a high degree of permanence, the superiority in mature size, say, of animals selected for large size at 12 as opposed to 9 months of age would appear to be considerable.

A stochastic representation of the growth of linear body measurements is put forward in an attempt to give an integrated description of the emergence and permanence of size differences. The proposed linear growth process is $Y_t = pY_t - 1 + M(1 - p) + E_t$, where Y_t is the size at age t, M is mature size, p is a constant growth potential, and E_t is a growth error, i.e., a deviation from expected growth brought about by illness, say, or some change in feeding. This process takes into account, for example, the broad fact that with respect to the rate of maturing in liberally fed animals, each linear body measurement occupies a fixed position relative to every other throughout life.

Tazima, Yatarô. Mutation Response Pattern of Silkworm Germ Cells to X-Rays. *National Institute of Genetics, Misima, Japan.*

A marked difference has been revealed in the sensitivity and mutability of the spermatogenic cells of *Drosophila* and mouse to X-rays in wide varieties of developmental stages. In both of these animals germ cells in different phases exist together in the same testis and the response pattern was determined by testing successive broods at a definite interval after irradiation. It may, however, be difficult to tell exactly which type of spermatogenic cells are being tested when the adult males have been irradiated. The use of silkworms has an advantage for analysing the problem more precisely because most of the germ cells develop almost synchronously with the development of the parents in both male and female.

X-irradiation was administered to male and female germ cells of the wide-type silkworm at definite stages from fourth larval instar to post pupa at 250, 500, 1,000, 2,000, 3,000 and 4,000 r and mating was made to non-irradiated double recessive *pe re* partners. Response patterns were determined with respect to visible mutation rates at marked loci and dominant lethal mutation rates. In treated males, visible mutation rates showed their peak at the sixth day of stadium 5 (larva), i.e., mostly at the stage of spermatids, and were less in earlier and later stages; while incidence of dominant lethals was highest at the second day of stadium 5, approximately at the spermatocyte stage, which coincided with the stage of marked damage in germ cells.

The irradiated female germ cells showed nearly the same mutation rates at relatively low levels throughout varieties of stages of oogenesis before mid-pupal stage, but after this stage a sudden increase was observable in the mutation rate to the same level as the peak in the male germ cells.

The induced visible mutation rates per r were several times higher in spermatogonia and ten times higher in mature sperms than those of *Drosophila.*

TEODOREANU, NICOLAE. L'ophthalmie héréditaire des agneaux de race Tzigaia.

Académie de la République Populaire Roumaine, Bucarest, Roumanie.

En 1945, on a signalé la présence de trois agneaux atteints d'ophthalmie dans l'élévage de "tzigaia bucalai" de Slobozie, Roumanie. Ils ont été sacrifiés. Chaque année, on signalait deux à quatre agneaux atteints d'ophthalmie. A partir de 1951, ce nombre a diminué par suite de l'élimination de la reproduction des parents respectifs. En 1949 et 1950, on a entrepris une étude sur sept de ces agneaux atteints d'ophthalmie. Ces agneaux à la naissance ont un aspect et un poids normaux, ils présentent une grande tache blanche sur le front et la nuque et parfois le bout de la queue est blanc; ils sont vifs, rarement languissants. Les agneaux tzigaia typiques ont la tête et l'extrémité des membres noires, le bout de la queue gris. Deux ou trois jours après leur naissance et parfois même le premier jour, les symptômes de l'ophthalmie apparaissent: conjonctivite, infiltration sanguine diffuse de la cornée, kératite, ulcères sur la cornée, photophobie, cataracte, écoulement de l'humeur aqueuse. L'œil est perdu en deux à trois jours. Les agneaux perdent leur vivacité et leur appétit; à l'âge de deux à trois semaines apparaissent les troubles digestifs (diarrhée), pulmonaires (congestions, broncho-pneumonies), nerveux (ils tournent en cercle). La peau est sèche, la laine tombe, il y a eczéma et le bord des oreilles est enflé. La température oscille, atteint 41° C. La respiration est irrégulière, tantôt accélérée, tantôt rare, profonde ou superficielle, dyspnéique.

Le traitement avec les vitamines A et D, avec la pénicilline, etc., arrête l'évolution des phénomènes sans toutefois les guérir. Dès l'arrêt des injections de vitamines, les phénomènes oculaires et autres réapparaissent. On a réussi à prolonger la vie d'un agneau mâle durant 18 mois; la spermatogénèse manquait. Les agneaux malades provenaient de parents reproduits par accouplement parent × enfant et consanguinité étroite, méthode qui a servi à la formation de l'élevage de Tzigaia à partir du bélier L_3.

L'ophthalmie des agneaux est de nature héréditaire étant due à un gène semi-létal récessif probablement nouveau et lié au gène, dont le siège est dans le chromosome responsable de la tache blanche. Les agneaux à gène semi-létal à l'état homozygote se reconnaissent à la tache blanche. Ils meurent à l'âge de 2½–3½ mois. Le gène a un effet pleitropique, primaire sur l'œil et secondaire sur l'appareil digestif, respiratoire, etc. L'ophthalmie héréditaire a probablement apparu sous forme de mutation.

THEILER, KARL. Notochord and Morphogenesis of Hereditary Malformations in Mice. *Department of Anatomy, University of Zürich, Zürich, Switzerland.*

Previous investigations (Theiler, 1950; Watterson, 1954; Holtzer *et al.*, 1955; Strudel, 1955) have shown the notochord to favour cartilage formation of vertebral bodies and differentiation of interverterbral discs in amphibia and birds. Similar experiments in mammals being extremely difficult to conduct examination of mutant mice has yielded rich material for the analysis of the effects of a "genetic notochordectomy" at different stages of development and at different levels. The recessive mutation "truncate" (obtained from M. Dickie, Bar Harbor) suppresses notochord formation in the sacral and/or caudal region from the very beginning, with the same consequences as notochord deficiency in amphibia: namely, fusion of myotomes across the midline, "Basalmassentypus" of neural tube, malformation or lack of vertebrae. The well-known mutations of the brachyury and tailless have been described to affect the notochord (Chesley). The shortness or absence of the tail seems to be due to the absence of its posterior part. The mutation "Short Danforth" (obtained from S. Waelsch) does not suppress notochord formation from the very beginning, but leads to a premature breakdown over its whole length. It seems that the dorso-ventral flattening of all vertebral bodies may be a consequence of this defect, as well as the typical luxation of the axis found in practically all *Sd*-animals. From these three mutants, it can be judged that the notochord may be an important structure in the formation of a normal vertebral column.

THERMAN, EEVA. The Ineffectiveness of Indole-3-acetic Acid on the Meiosis of *Eremurus. Botanical Institute, Helsinki, Finland.*

Indole-3-acetic acid is obviously one of the important factors in mitosis, as shown, for instance, in tissue cultures and the root tips of various plants. Nothing, however, is known concerning its possible role in meiosis or its effects on this process. To elucidate this point, a series of experiments was made with *Eremurus himalaicus* as the experimental plant. The experiments were carried out by putting cut inflorescences in the solution to be tested or by halving the spikes and floating them directly on the solution. The highest concentration of indole-3-acetic acid used was 50 p.p.m. and the longest time of exposure 5 days. This treatment did not seem to have the slightest effect on the course of meiosis, which was checked in preparations made every day during the treatment. The various possible explanations for this ineffectiveness are discussed.

THIEME, F. P. *See* BUETTNER-JANUSCH, JOHN, *et al.*

THODAY, J. M. Effects of Disruptive Selection. *Department of Genetics, Sheffield University, Sheffield, England.*

Stabilising selection is here defined as selection which favours the same (mean) phenotype in every generation. Disruptive selection is defined as selection which picks out both extreme phenotypes in every generation. A population of *Drosophila melanogaster* has been exposed to disruptive selection by mating opposite extremes for 40 generations (disruptive selection with negative assortative mating). Another has been exposed to disruptive selection for 31 generations by mating like extremes together and selecting both extremes from the offspring (disruptive selection with positive assortative mating). A third has been exposed to 30 generations of stabilising selection. All were derived from the same wild-stock. Character sternopleural chaeta-number, 4 single-pair cultures are used each generation. Heritability has been tested in these populations by taking out high and low directional selection lines and recording the divergence of their mean chaeta-numbers. Divergence is greatest in the disruptive selection lines, least in the stabilised lines, and (at least in the first generation) intermediate in the foundation wild-stock. It therefore seems that disruptive selection may increase and stabilising selection decrease the effective variety of chromosomes in a Mendelian population. Disruptive selection may therefore be capable of producing polymorphism as Mather has suggested.

The line exposed to disruptive selection with positive assortative mating can be regarded as consisting of two sub-populations, one selected for high and the other for low chaeta-number. Each generation is set up by crossmating the two so that there is maximal (50%) gene-flow between the two. Despite this the two have diverged, showing that isolation is not a prerequisite of such divergence. Random mating involves only 25% gene-flow. Disruptive selection should make possible considerable divergence with 25% gene-flow.

Populations with 25% gene-flow are being maintained and may have progressed sufficiently for report at the Congress.

THOMPSON, MARGARET W. Twin Studies in Cerebral Palsy. *University of Alberta, Edmonton, Alta., Canada.*

Twins are three to four times as common among patients of the Edmonton and Calgary Cerebral Palsy Clinics as in the general Alberta population. The high susceptibility of twins to cerebral palsy is well recognized, and the particular difficulties of a twin pregnancy and parturition are considered to be causal factors in cerebral palsy. However, an analysis of zygosity and concordance in our series shows that monozygotic twins may exhibit concordance for certain types of cerebral palsy, but not for other types. No concordant dizygotic pairs have been observed. The significance of these findings in regard to the etiology of cerebral palsy will be discussed.

THOMSON, L. *See* FOSTER, M.

Ting, Y. C., Inversions and Other Characteristics of Teosinte Chromosomes. *Harvard University, Botanical Museum, Cambridge, Mass., U.S.A.*

Three teosinte varieties, Huixta from northern Guatemala, Durango and Nobogame from Mexico, were crossed with two selected inbred strains of maize and cytological studies were made of the F_1 hybrids.

No inversions were found in the F_1 hybrids of Huixta teosinte with maize. This teosinte, however, differs from other previously studied Guatemalan teosintes in having the majority of its knobs located internally. At diakinesis, among 585 microsporocytes examined, 12.3% had two univalents, 0.8%, four univalents.

F_1 hybrids of maize and Durango teosinte proved to be heterozygous for two practically terminal inversions located on the short arms of chromosomes 8 and 9. The inversions include 59% and 56% respectively of the short arms of these chromosomes. At both anaphase 1 and anaphase 2, dicentric bridges and acentric fragments were found. At diakinesis, among 514 cells examined, 0.8% had two univalents. More than two were never observed. Two previously unreported knob positions were found in Durango teosinte: one on the long arm of chromosome 8, and the other on the long arm of chromosome 9.

F_1 hybrids of maize and Nobogame teosinte were heterozygous for 3 inversions, 2 of which are practically terminal and are located on the short arms of chromosomes 8 and 9. The *In 8* represents 62% of the short arm, while the *In 9* represents 59% of the short arm. The third inversion, a paracentric one, is located on the long arm of chromosome 5. The length of the inverted segment is equal to about one-half of the long arm of this chromosome. Both dicentric bridges and acentric fragments were found at anaphase 1 and anaphase 2. Among 514 cells studied at diakinesis, 11.8% had two univalents, 0.4%, 4 univalents. The chromosomes of Nobogame teosinte have only a few knobs: a large terminal knob on the short arm of chromosome 7 and small to medium knobs on chromosomes 1, 2, 4 and 6.

Tokunaga, Chiyoko. The Y Chromosome in Sex Determination of *Aphiochaeta xanthina* Speiser. *Zoology Department, University of California, Berkeley, Calif., U.S.A.*

Certain substrains of *Aphiochaeta xanthina* Speiser ($2n = 6$), belonging to Phoridae (Diptera), derived from strains collected in Okinawa, Japan, show peculiar genetic phenomena. When a male of the substrains is crossed to *brown* or *Delta* female (both third chromosome genes in the original strains), these mutants behave as if they are partially sex-linked in the following generations. On the other hand, when an *Abrupt* or *occhi chiari* female (both are partially sex-linked genes on the X and Y chromosomes) is crossed to the male of the substrains, the *Abrupt* or *occhi chiari* characters segregate as if they are autosomal. These new types of genetic behavior were first found in the males of two wild strains which had reverted from the original *short arista* mutant stock from Okinawa, and later in the male of the *occhi chiari* mutant stock of a Neapolitan strain.

As a possible explanation of the phenomena, the author proposes a working hypothesis involving a Y-linked male determining factor as follows. In this species, there is a strong male determining factor in the normal Y chromosome, and the male sex is determined by the presence of this factor. At times this factor translocates to the third chromosome so that the "special" male which arose now has a male determining III-Y chromosome, instead of a normal Y chromosome. By crossing over between a normal third chromosome and the III-Y chromosome in the special male, the genes which were on the normal third chromosome become linked with the male factor on the III-Y chromosome and show male-limited inheritance. Data concerning the role of the X chromosome in sex determination have not yet been obtained.

Towner, J. W. Amphiploidy in the Cultivated Marigolds (*Tagetes*). *University of California, Los Angeles, Calif., U.S.A.*

A genetic, cytological and morphological analysis of the three cultivated marigold species revealed that *Tagetes patula* L. ($2n = 48$) is a typical genomic allotetraploid which probably originated in Mexico by hybridization between *T. erecta* L. ($2n = 24$) and *T. tenuifolia* Cav. ($2n = 24$), or species closely related to them, and became established as a fertile species by chromosome doubling. The three species were fully fertile and normal in meiosis with no evidence of multivalents. Hybrids between the putative parent species *T. erecta* × *T. tenuifolia* were difficult to produce, very weak, almost completely sterile, and averaged only 2.4 bivalents per PMC. The sterile triploid ($2n = 36$) hybrids *T. patula* × *T. erecta* and *T. patula* × *T. tenuifolia* usually had 12 bivalents and 12 univalents at MI. The corresponding hexaploids ($2n = 72$) were only partially fertile, frequently had the maximum expected pairing of 12 quadrivalents plus 12 bivalents at MI, and showed complex segregations when self-fertilized. A fertile, true breeding, synthetic allotetraploid, *T. erecta-tenuifolia*, was produced by doubling the chromosome number (with colchicine) of the corresponding sterile diploid hybrid. This synthetic allotetraploid was morphologically, cytologically and genetically very similar to the natural allotetraploid *Tagetes patula*. Hybrids between these two allotetraploids were easily produced, highly fertile, and had 24 bivalents in 80% of MI (no multivalents). F_2 segregations of these hybrids demonstrated that *T. patula* and *T. erecta-tenuifolia* held in common the independent gene loci *sg* (flower doubleness), *lt* (short-day flowering), *a* (ligule anthocyanin), and *ai* (ligule anthocyanin inhibitor). Thus the behavior of the various hybrids indicated that the structurally distinct genomes of *T. erecta* and *T. tenuifolia* are very similar to the corresponding subgenomes of *T. patula*.

Townsend, J. Ives. *See* Cordeiro, A. R., *et al.*

Trasler, Daphne G., and F. C. Fraser. Factors Underlying Strain, Reciprocal Cross, and Maternal Weight Differences in Embryo Susceptibility to Cortisone-Induced Cleft Palate in Mice. *McGill University, Montreal, Canada.*

The developmental age (as measured by external morphological criteria) at which embryonic palate closure occurs in mice was found to differ in the A/Jax and C57BL strains of mice, the reciprocal crosses, and backcrosses, in the following manner: C57BL ♀ × C57BL ♂ = C57BL ♀ × A/Jax ♂ < A/Jax ♀ × C57BL ♂ < (A/Jax ♀ × C57BL ♂) ♀ × A/Jax ♂ = (C57BL ♀ × C57BL ♂) ♀ ×

A/Jax ♂ < A/Jax ♀ × A/Jax ♂. This series corresponds closely to the order of the susceptibility of these crosses to the cleft palate producing properties of cortisone, such that those crosses with palate closure occurring earlier in development show greater resistance.

The frequency of cortisone-induced cleft palate embryos from "light" mothers has been shown to be significantly higher than from "heavy" mothers (Kalter, J. Exp. Zool. *134*:449). In the present study the palate closure of untreated backcross embryos from "light" and "heavy" mothers was compared. It was found that there was a slight, but significant, tendency for palate closure of embryos from "light" (susceptible) mothers to start later than that of embryos from "heavy" (resistant) mothers.

Among cortisone-treated backcross embryos after the normal time of palate closure, those with cleft palate tended to have lower (p .1–.05) morphological ratings and lower (p .02–.01) weights than embryos from the same litters with palates closed.

The maternally influenced (reciprocal cross and weight) differences in embryonic susceptibility to cortisone-induced cleft palate could be due to differences in maternal handling of the cortisone or to differences in embryo reaction to cortisone. The present studies suggest that the determining factor is the state of readiness of the particular embryo and that this readiness has been predetermined by the maternal physiological state, the maternal genotype, the embryonic genotype and the interaction of these factors.

TSUDA, SEIZO. Some Features of Fine Structure of Hyphal Cells of Wild Type of *Neurospora crassa*, as Observed with the Phase and Electron Microscope. *Department of Anatomy, University of Washington, School of Medicine, Seattle, Wash., U.S.A.*

Most of the observations were made on vegetative young mycelia cultured on minimal medium. In living hyphae, phase contrast microscopy reveals nuclei, large bright granules, many mitochondria and minute dense granules. The nuclei are commonly rounded or oval and are frequently observed to move from one cell to another through the center pores of transverse cell walls. The mitochondria appear round or as short rods. All the inclusions inside the cytoplasm show vivid motion and are continuously changing their position. Five or six nuclei can be observed in each cell.

As seen with the electron microscope, the *Neurospora* hyphae are surrounded by a cell wall about 2,300 Å thick. The cell membrane is about 60 Å thick and is very extensively folded, forming many small processes and pits or caveolae close to the inner surface of the cell wall. The surface area of the cell membrane is much greater than that of the cell wall.

Nuclei are surrounded by inner and outer membranes, featured by pores. The diameters of the nuclei are 1.5 to 2 microns.

The profiles of the mitochondria are predominantly ellipsoidal and are 0.2 to 0.3 microns in diameter. They are surrounded by membranes and show inner fine structure similar to mitochondria in animal cells, with a matrix interrupted by flattened cristae. At various sites in the cytoplasm, one may observe a number of extremely dense granules about 2,500 Å in diameter. These appear singly or in clumps and resemble lipid granules in the higher organisms. One can also recognize endoplasmic reticulum in the cytoplasm. This shows flattened vesicles bounded by membranes.

Thus, the hyphae cells of *Neurospora* have many features of fine structure resembling those described for a number of animal and higher plant cell types. However, with respect to certain details, specialized developments can be recognized.

TURCOTTE, E. *See* BURNHAM, C. R., *et al.*

TURPIN, RAYMOND. *See* LEJEUNE, JERÔME.

UCHIDA, IRENE A. The Genetics of Hypercholesterolemia. *Hospital for Sick Children, Toronto, Canada.*

A large Ontario kindred with essential hypercholesterolemia has been investigated in detail with the purpose of clarifying the genetic mechanism involved. The proband is a severely affected child, the offspring of two unrelated individuals with hypercholesterolemia. The abnormal gene can be traced through several members of both families as a simple autosomal dominant with complete penetrance, the severe condition in the proband representing the homozygous state. This is evidence supporting a theory of incomplete dominance.

Although it has been known for some time now that an abnormally high cholesterol level is an inherited trait, the exact mode of inheritance has in recent years been a controversial subject. It is evident that the argument can be resolved by using a different diagnostic criterion which must take into consideration primarily the cholesterol level at specific ages rather than the mere presence or absence of xanthomata and coronary artery disease. Since cholesterol levels increase with age and since the appearance of xanthomata is even more dependent upon the passage of time, detection of homozygosity should be restricted to children. At the present state of clinical knowledge the homozygote would appear to be sublethal.

Moreover a continuous variable such as serum cholesterol levels raises the problem of defining the limits for the norm. These ill-defined limits, as well as the influence upon lipid metabolism by several abnormal conditions should caution one from accepting a slightly elevated cholesterol level as diagnostic of essential hypercholesterolemia without a suggestive family history.

UHRING, JOSEPH. *See* EMSWELLER, S. L.

ULRICH, HANS. The Mutagenic Action of X-Rays on Uncleaved *Drosophila* Eggs and Its Dependence upon Oxygen. *Zoologisches Institut der Eidg. Technischen Hochschule, Zürich, Switzerland.*

Uncleaved eggs of *Drosophila melanogaster* were X-rayed totally or partially, the nucleus-containing anterior or the non-nucleated posterior halves being treated separately. Embryonic and postembryonic mortality was registered, and dose-effect curves were constructed. The frequencies of sex-linked recessive lethals were determined by a modified Muller 5-technique.

The shape of the curves together with other criteria suggests that killing of eggs by X-raying them totally or in their anterior halves is due to the induction of dominant lethals in the irradiated nucleus, whereas X-raying of posterior halves kills the egg by damaging the cytoplasm. In all three cases the mortality is greatly reduced if we irradiate in pure nitrogen instead of in air.

Total irradiation with 1,000 or 1,050 r results in 7.27% sex-linked recessive lethals. This surprising high frequency may be due to a higher mutation sensitivity of the zygote or to absence of selective elimination of gametes with induced recessive lethals, which might happen in the common case of the irradiation of adult males. X-raying of anterior halves gives comparable results.

Irradiation of posterior halves (with much higher doses because of their much lower radiosensitivity) induces recessive lethals also. Their frequencies are correlated with the embryonic mortality in the same manner as those of X-raying the total eggs or anterior halves. There are good reasons to believe that the recessive mutations induced in the nonirradiated nucleus by the irradiation of the cytoplasm of the posterior half are due to an indirect mutagenic action rather than to scattered X-rays or secondary electrons which might have reached the shielded nucleus.

Embryonic and postembryonic mortality, as well as frequency of recessive lethals, is greatly reduced if total eggs or anterior halves are X-rayed in pure nitrogen instead of in air. When, however, posterior halves are X-rayed, nitrogen only reduces the embryonic and postembryonic mortality, but apparently not the frequency of recessive lethals.

In conclusion, the method of irradiation of uncleaved eggs of *Drosophila* instead of adult flies (as is usually done) seems to offer some advantages in analysing the mutagenic action of radiation, especially the indirect or the delayed effects, also the dependence of mutagenesis on oxygen and on other chemicals, as well as the analyses of other problems.

UMAERUS, MAGNHILD. *See* **GOWEN, JOHN W.**

VAARAMA, ANTERO, and MATTI SULKINOJA. On the Origin of Variability in China Aster (*Callistephus chinensis*). *Department of Botany, University of Turku, Turku, Finland.*

Callistephus chinensis, the only species of its genus, introduced to Europe in the year 1728, immediately acquired great popularity as an ornamental. A great number of garden forms differing from each other mainly by flower characteristics have been developed. Since cytogenetic mechanism leading to polymorphism has not been sufficiently studied, 30 types representing all the commonly cultivated garden forms were examined cytologically.

All the types investigated were diploid ($n = 18$). No analysable differences were observed in the karyotypes of fairly symmetrical structure. Two pairs of satellite chromosomes are present, both of them characterized by a segment of heterochromatic material.

Both mitosis and meiosis of the wild type is regular and the pollen good. Among the garden forms numerous examples of lability in the chromosome mechanism were found. One plant was aneuploid ($n = 19$). A number of plants with small fragment chromosomes were observed. In meiosis numerous cases of multivalent and univalent formation were noticed. Usually pollen formation was also irregular. Many other types of irregularity in the meiotic mechanism were encountered, but most of them were of local occurrence within the flower head and probably are often connected with the development of pleniflory with its tendency to cause sterility.

The China aster seems to be a counterpart of *Lathyrus odorarus* in its development of polymorphism. One rather monotypic diploid species has given origin, mainly by gene mutations and without hybridization and polyploidy, to a wealth of garden forms. Although it was not possible to establish any correlation between cytological deviations and particular phenotypes, the great lability in the chromosome mechanism may also be considered to have contributed to the origin of the variability.

VALENCIA, J. I. *See* VALENCIA, R. M.

VALENCIA, R. M., J. I. VALENCIA, and W. F. KIRSCHBAUM, A Quantitative and Qualitative Analysis of Mutations Induced by Fast Neutrons. *Atomic Energy Commission of Argentina, Buenos Aires, Argentina.*

Drosophila melanogaster males of a stock which has no visible genetic markers but which has, in the X-chromosome, the inversions sc^{S1} In49 sc^{8} (H. J. Muller's "Insc" stock) were irradiated with fast neutrons delivered by a cascade accelerator. The males were collected as virgins and aged 2–3 days before treatment. They were then mated to virgin females of a stock which contains in one X-chromosome y sc^{S1} B In 49 v and in the other a series of recessive markers. The males were carried through five broods, brood A lasting three days, broods B, C, D and E two days each. In each brood they were given fresh virgin females. Thus the offspring of the different broods should represent sperm that was irradiated in successively earlier stages of spermatogenesis. Three doses were given, these being equivalent in effectiveness (in terms of percentage of recessive lethals in the X) to approximately 750 r, 1,500 r and 2,250 r of X-rays. All mutations, visibles and lethals, are being analyzed cytogenetically. A considerable number of mutations have already been collected, but a very large number will be required before conclusions can be drawn. Results will be discussed at the Congress.

VAN DER VEEN, J. H. *See* PRAKKEN, R.

VETUKHIV, M. O., and J. A. BEARDMORE. Effect of Environment upon the Manifestation of Heterosis and Homeostasis in *Drosophila pseudo-obscura. Department of Zoology, Columbia University, New York, N.Y., U.S.A.*

To investigate the thesis that the manifestation of heterosis in hybrid F_1's may be different in different environments, two laboratory populations of *Drosophila pseudo-*

obscura were crossed and P, F_1 and F_2 were compared concurrently in three environments. Larval viability, egg production and wing asymmetry were used as measures of heterosis.

At 25°C we found (*a*) heterosis in larval viability and significantly lower variation (= superior homeostasis) in survival; (*b*) heterosis in egg production; but (*c*) no statistically significant differences in wing asymmetry. At 22°C no heterosis was detected.

At temperatures fluctuating between 17°C and 27°C (mean = 22°C) no heterosis was detected.

There are two possible explanations of these results; both however assume that 25°C is for these flies a relatively stringent and difficult environment. The first involves "special adaptation" related to the fact that the parental populations had been maintained at 15°C for a number of years and are therefore adapted to this temperature. The 22°C and F 17°/27° environments are consequently less difficult (because less distant from 15°) than is the 25° condition. The second explanation rests on "general adaptation": that is, for the species of *D. pseudo-obscura* as a whole 25°C is a less favorable environment than either of the others. At present we cannot tell which of these two possibilities may be correct and more work is needed to elucidate this problem. It seems reasonable to assume, however, that in this experiment 25°C is the most unfavorable condition (larval viability, shortest life, lowest egg production). These results suggest that there may often exist a "threshold" of environmental stringency which must be reached before heterosis is manifested.

VICKERY, ROBERT K., JR., and BARID B. MUKHERJEE. Cytogenetic Studies of the Patterns of Evolution in the *Mimulus guttatus* complex (Scrophulariaceae). *Department of Genetics, University of Utah, Salt Lake City, Utah, U.S.A.*

The relationships of the various members of the *Mimulus guttatus* complex were studied by means of chromosome counts, experimental hybridizations, and the analysis of chromosome pairing in the hybrids. *Mimulus guttatus*, the main species of the complex, has $n = 14$ chromosomes although the tetraploid-like behavior of the chromosomes of two of its races indicate that the base number is $x = 7$. Two other races of *M. guttatus* exhibit irregular meioses resulting in functional microspores with from 13 to 16 chromosomes. Possibly this is the mechanism that produced the aneuploidy frequently observed in the complex.

Mimulus guttatus hybridizes readily with *M. lyratus* ($n = 14$) and with the $n = 14$ races of *M. nasutus*. Their chromosomes pair regularly indicating the presence of a common genome in these three species. Moderate to strong barriers separate *M. guttatus* from the $n = 13$ races of *M. nasutus* and from *M. tilingii* ($n = 14, 15$), *M. glaucescens* ($n = 14$), *M. glabratus* ($n = 14$) and *M. platycalyx* ($n = 15$). The chromosomes of these species show some synaptic irregularities in their hybrids with *M. guttatus*. However, despite the presence of aneuploidy in several cases, the genomes of these five species are still essentially homologous to that of *M. guttatus*.

The same genome is found in the South American species, *M. parviflorus* ($n = 45$) and *M. pilosiusculus* ($n = 46$). F_1 hybrids of these species with *M. guttatus* are sterile, but their chromosomes regularly exhibit 14 bivalents and 31 or 32 univalents in meiosis. The basic genome appears to have evolved appreciably in

North American *M. corallinus* ($n = 24$). The sterile F_1 hybrids of *M. corallinus* × *M. guttatus* exhibit from 2 to 14 bivalents plus from 0 to 4 trivalents. Perhaps *M. corallinus* is an aneuploid derivative of a tetraploid form. Lastly, the genome of the South American *M. luteus* ($n = 30, 31, 32$) appears to be distinct as it is doubtful that any of its chromosomes pair with those of *M. guttatus.*

The *Mimulus guttatus* complex contains at least one and perhaps two distinct genomes. These basic genomes have evolved by numerous gene mutations, frequent aneuploidy, and occasional polyploidy to produce the many polymorphic species and races of the complex.

VITAGLIANO, TADINI G. *See* MONTALENTI, G., *et al.*

VOGEL, FRIEDRICH. Family Investigations on the Genetics of the "Normal" EEG in Man. *Max Planck-Institut für vergleichende Erbbiologie und Erbpathologie, Berlin-Dahlem, Germany.*

By comprehensive investigations of twins it has been shown that the individual character of the EEG under normal conditions is almost exclusively determined by genetic factors. This result encouraged us to begin a more exact genetic analysis on the basis of family studies. We started with two special types of the normal EEG: the moderately frequent low voltage EEG, and the EEG type with predominantly 4–5/sec. α-variants, which is very rare. In both we were able to detect a relatively simple genetic situation, which is discussed in detail. We would like to emphasize, however, that these investigations are to be considered only as the first step into the analysis of a group of traits which ultimately may prove to be genetically very much more complex.

VOGEL, HENRY J. *See* COCITO, CARLO.

VOJTÍSKOVÁ, MARTA. Distant Hybrids from Parents with Reduced Immunological Reactivity. *Czechoslovak Academy of Science, Institute of Biology, Department of Experimental Biology and Genetics, Prague, Czechoslovakia.*

In hybrids between guinea-fowl hen and domestic fowl cock, if they hatch at all, there is usually a high incidence of malformation. Adult hybrids have been described only twice.

We have attempted to determine whether a distant cross of the above combination might not be favourably influenced by a decrease in the reciprocal immunological reactivity of both the parent birds. Present results lend support to the feasibility of this assumption since the fertilization percentage in experimental crossings far exceeded that of the control guinea fowls and since we obtained four hybrids which have survived into maturity (they are now 16–18 months old).

Procedures influencing immunological reactivity of experimental animals were as follows: in guinea-fowl hens long-term administration of fowl blood during maturity, and in cocks intra-embryonic injections and long-term administration of guinea-fowl blood from birth.

The histological examination of the gonads of four hybrids from experimental crossing, which died during hatching, showed that all were males. The seminiferous tubules were normally developed, but did not contain spermatogonia, so that the hybrids would evidently have been sterile.

The serological analysis showed no "hybrid substance" in our hybrids apart from the common and specific antigens for both parent species. Further experiments are in progress.

VON BORSTEL, R. C. Dominant Lethal Mutations in *Habrobracon* and *Drosophila*. *Biology Division, Oak Ridge National Laboratory, Oak Ridge, Tenn., U.S.A.*

In the parasitic wasp *Habrobracon*, unfertilized eggs become normal haploid males; fertilized eggs, diploid females. Three types of dominant lethal mutations have been identified in *Habrobracon*. Type I dominant lethality kills the embryo during the first few cleavages and is believed to represent a defect in deoxyribonucleic acid synthesis. These account for 60–80% of the deaths when eggs or sperm are irradiated and Type I lethality is unaffected in expression by fertilization. Type II kills the embryo after blastula formation and before the embryo hatches if the embryo is haploid, after hatching if the embryo is diploid. These are called conditionally delayed dominant lethal mutations and are characteristic, with Type I, of *Habrobracon* eggs irradiated in the first meiotic metaphase. They are believed to be manifestations of chromosome imbalance. Type III kills the embryo after blastula formation and before hatching whether the embryo is haploid or diploid. Death may occur later in embryogeny in the diploids than in the haploids, but always before hatching. Type III, with Type I, is characteristic of *Habrobracon* eggs irradiated in the first meiotic prophase.

In *Habrobracon*, five translocations, when heterozygous, produced aneuploid embryos that all died under the same circumstances that characterize Type II dominant lethality. Type III dominant lethals are exactly mimicked by aneuploid embryos from triploid *Habrobracon* females, indicating that Type III radiation-induced dominant lethality may be caused by chromosome loss. Type I dominant lethality remains specifically induceable only with mutagenic agents.

In *Drosophila*, dominant lethal analogues of Type I and Type III have been observed following X-irradiation. Type III is mimicked in *Drosophila* by aneuploids from triploid females or translocation heterozygotes; Type I is specifically induced by radiation. Even *Drosophila* zygotes deprived by genetic means of the X and Y chromosomes and lacking the associated nucleoli develop further than Type I dominant lethal embryos.

WAGNER, R. P., and ARLOA BERGQUIST. The Accumulation of Probable Isoleucine and Valine Precursors by a Mutant of *Neurospora*. *Department of Zoology, University of Texas, Austin, Tex., U.S.A.*

A mutant of *Neurospora crassa*, T304, which will grow only in the presence of both isoleucine and valine, accumulates two compounds, acetylethylcarbinol and acetylmethylcarbinol in its growth medium. These compounds have been identified as their pteridine derivatives after their reaction with 2, 4, 5-triamino-6-hydroxypyrimidine dihydrochloride.

Acetylethylcarbinol and acetylmethylcarbinol can be derived from alpha-aceto-alpha-hydroxybutyric acid and alpha-acetolactic acid, respectively, by decarboxylation. Decarboxylation occurs spontaneously at acid pH, but is also catalyzed by an enzyme in *Neurospora* which is active in the acid range. Other work has shown that alpha-acetolactic acid and alpha-aceto-alpha-hydroxybutyric acid are probably precursors of valine and isoleucine respectively. Hence the demonstration that a mutant requiring valine and isoleucine accumulates the derivatives in an acidic milieu (the mutant will grow only at an acid pH) indicates that these acids are indeed precursors to valine and isoleucine.

The carbinols accumulate in the medium in detectable amounts only when isoleucine and valine are present in sub-optimal amounts for growth. This is probably, therefore, another example of an end product inhibiting its own synthesis.

T304 segregates as a single gene. It is linked to 16117, another isoleucine-valine mutant.

WAGNON, K. A. *See* ROLLINS, W. C.

WAHRMAN, J., and A. ZAHAVI. Cytogenetic Analysis of Mammalian Sibling Species by Means of Hybridization. *Department of Zoology, The Hebrew University, Jerusalem, Israel.*

Three allopatric forms of *Gerbillus pyramidum* (Rodentia : Gerbillinae) are indistinguishable by conventional taxonomic criteria, but differ widely in the form and numbers of their chromosomes: (1) Algeria—2*n* ♂ 40, metacentric chromosomes (m.c.) 38, acrocentric chromosomes (a.c.) 2, chromosome arms (c.a.) 78; (2) Israel-coastal plain—2*n* ♂ 52, m.c. 22–24, a.c. 28–30, c.a. 74–76; (3) Israel-Negev—2*n* ♂ 66, m.c. 10, a.c. 56, c.a. 76; (4) hybrid between (1) and (3) —2*n* ♂ 53, m.c. 24, a.c. 29, c.a. 77. These data suggest a Robertsonian relationship.

A male hybrid was obtained by mating a female from the Israel-Negev population ($2n = 66$) to a male from Beni-Abbes in Algeria ($2n = 40$). The fertility of the hybrid was not definitely ascertained, but on dissection the testis proved to contain spermatozoa displaying no gross morphological deviations from the normal. Spermatogonial metaphase plates possess 53 elements. Diakineses and first metaphases reveal a considerable regularity in chromosome association: the 15–17 elements comprise 3 bivalents, 9–11 trivalents which result from the pairing of 2 acrocentrics with 1 metacentric chromosome and 3–4 chain configurations each made up of 5–7 chromosomes. A few cells contain a single univalent, which may have become detached from the end of a chain. Second metaphase plates are of many kinds differing in number of chromosomes and chromosome arms.

The analysis of the synapsis in the hybrid thus discloses a high degree of genetic affinity between populations which are some 4,000 km. apart and which differ by as much as 26 chromosomes. The numerous trivalents bear witness to the homology of acrocentrics from the Negev population to metacentrics of the Algerian form. The compound chains suggest that certain metacentrics of the two genomes are homologous for only one of their arms (Oenothera fashion) owing to independent Robertsonian changes.

The three strains are interpreted as a series of allopatric sibling forms of common ancestry. The main discrepancy between its members is due to organization of the genetic material in different numbers of linkage groups. The evolutionary significance of changes in chromosome numbers between related species are discussed.

WAKONIG, RESA, and J. T. ARNASON. Effects of Triazine on Chromosomes. *Biology Department, University of Saskatchewan, Saskatoon, Sask., Canada.*

When roots are treated with the alkylating agent 2:4:6 tri (ethylene imino)–1:3:5 triazine, the compound is able to penetrate the nucleus and produce conspicuous changes in the chromosomes. Roots of the bean, *Vicia faba*, treated for 12 hours in a 10^{-5} M solution of triazine at a constant temperature of 20°C have few aberrations until about 12 hours after the conclusion of treatment; however, anaphase aberrations become numerous at 12–36 hours with the peak frequency near 24 hours. At the peak nearly 30% of the cells are disturbed. When either the exposure time or the concentration is reduced there is a corresponding reduction in anaphase aberrations.

All roots collected for observations on metaphase chromosomes were prefixed in 0.05% colchicine for two hours. Collections were made at 12-hour intervals up to 72 hours. At the peak period (24 hours) many aberrations occur. These include free fragments (isolocus breaks), and many paired constrictions (incomplete breaks). Chromatid interchanges occur as shown by tri- and quadriradial configurations. Dicentric chromosomes have not been seen. A few intrachanges have been observed, all involving a part of the satellite (largest) chromosome. Sister reunion is more common in acentric than in centric fragments.

Most of the breaks and exchanges, whether involving the satellite chromosome or the short ones, occur in heterochromatic regions. In the satellite chromosome the regions on either side of the centromere are most frequently affected. In quadriradial configurations involving a satellite chromosome the other chromosome is nearly always a short one. Thus chromatid interchanges do not usually involve exchanges at homologous loci.

Barley seed germination is inhibited nearly 100% by a 24-hour treatment with 10^{-3} M triazine. Hexaploid wheat similarly treated has less than one-half of its seedlings stopped. Surviving seedlings are being grown for mutation studies.

WALKER, G. W. R., and R. A. MILLER. Linkage and Cytological Studies of Barley Mutants. *Department of Plant Science, University of Alberta, Edmonton, Alta., Canada.*

A number of mutants in commercial barleys have been investigated to determine the linkage groups involved. Ten of these mutants were produced at the University of Saskatchewan, two at the University of Alberta, and seven were from other sources. These mutants show linkage to known markers (*v, b, trd, n, br, r, s, an*). The following genes have been shown to be allelic: "bracteatum" and "third outer glume," and two glossy-leaf mutations in irradiated Montcalm and chemically treated Gateway. "Peto's mutant" carries the "orange lemma" gene, and two "bushy" mutants in irradiated Montcalm carry the "elongated outer glume" gene. A highly significant difference in linkage of genes on linkage group VI has been found between populations from the "intermedium" side-florets and central florets of the F_1 of a cross between a glossy-leaf mutant and Nigrinudum I. Translocations have been cytologically identified in the F_1's and F_2's of the testers Nigrinudum I and Brachytic 119 with "longawned outer glume 3" and "early 6" (54/1121 r65 and 54/1121 r95, Gustafsson), "sterile misshapen heads" and "cholorotic stripe" (L50–305 and L50–321, Lambert) and a "dense head" mutant (L5220, obtained from Dr. E. Larter, University of Saskatchewan).

WALKER, NORMA FORD. Nephrogenic Diabetes Insipidus and Its Occasional Association with Mental Retardation. *University of Toronto and Hospital for Sick Children, Toronto, Ont., Canada.*

During the years from 1952 to 1957 five children affected with nephrogenic diabetes insipidus were admitted to the Hospital for Sick Children in Toronto, Canada. A sixth child was located through an unaffected relative in the routine assembling of a pedigree. Of the six, two are considered to be mutations. The remaining four have extensive pedigrees with other affected members and all four family groups originate from a small area within a radius of 50 to 100 miles. The younger generations who have been interviewed do not know that they are related, but an intensive search concerning ancestors (who were early settlers in Canada) is in progress. Each family group knows only that his own family has the "curse of the water-drinkers." Inherited as a sex-linked recessive, the anomaly is mildly expressed in some carrier women. A serious aspect of the disease is its occasional association with mental retardation.

WALTER, EDWARD. *See* LAUPRECHT, EDWIN.

WALTERS, JAMES L. Translocation Heterozygosity in Natural Populations of *Paeonia brownii. Department of Biology, University of California, Santa Barbara College, Goleta, Calif., U.S.A.*

Paeonia brownii and *P. californica*, the only species of this genus native to the Western Hemisphere, closely resemble each other in morphology (they were long thought to comprise a single species) and in cytological behavior, and in the latter respect they differ markedly from the rest of the genus. *P. brownii* ranges over a large portion of the northwestern United States, with much climatic variety, while *P. californica* is restricted to a narrow coastal strip in California. Each species has evolved an extensive system of permanent structural heterozygosity, of which translocations are the most conspicuous feature. With $n = 5$, 7 different pairing types (combinations of pairs and rings of chromosomes) may be formed, and all 7 have been found in each species. Within the ring-forming types, it is possible to recognize a number of different zygotic types (arrangements of chromosomes) because 2 of the 5 pairs are morphologically distinguishable. It was earlier found that *P. californica* shows a predominance of plants with or without translocations (5 pairs of small rings), with the complete ring of 10 the least frequent type, and that most areas are cytologically heterogeneous, being occupied by 2 or more different pairing or zygotic types. *P. brownii*, in contrast, appears to consist predominantly of plants with large rings, the ring of 10 being the most frequent, and there are seldom more than two types and often only one in a given area. Thus *P. brownii* appears to have evolved farther along the road to extreme translocation heterozygosity than has *P. californica*. This observation is consistent with other evidence suggesting that *P. brownii* is the older of the two species, and with the evidence of its much wider geographic distribution. Preliminary studies indicate further similarities between the two species with respect to other cytological irregularities, including inversions and fragmentation.

WANG, CHI-WU, and T. O. PERRY. The Ecotypic Variation of Dormancy, Chilling Requirement, and Photoperiod Response in *Betula* Species. *School of Forestry, University of Florida, Gainesville, Fla., U.S.A.*

Under uniform growing conditions marked variation in the time of growth initiation and the time of cessation of height growth was observed between birches of different geographic origins. To study the ecotypic variation in *Betula* species, a collection of white birch (*Betula papyrifera*) and yellow birch (*B. alleghaniensis*) was treated with various combinations of winter chilling and photoperiod in a series of experiments over a three-year period. The experimental materials were raised from seeds obtained throughout their extensive natural range including Canada, Alaska, and twenty-one states of the United States.

The experiments showed that photoperiod exercised the controlling influence over the continuation of shoot elongation and the onset of dormancy as shown by the terminal bud formation. There was no indication that the time of the initiation of growth was influenced by the photoperiod, except possibly in certain unchilled plants. The breaking of dormancy in certain unchilled plants seemed to be hastened by the exposure to long-day.

For most of the plants, winter chilling of 38°–40° F resulted in early and normal breaking of dormancy in spring. But under Florida conditions, plants of extreme northern origin broke dormancy without winter chilling; and with only a few exceptions all the unchilled plants eventually broke dormancy after various periods of delay. The leafing out of the unchilled plants, however, usually took place on the basal branches or near the base of the stem with the terminal bud remaining dormant for periods ranging from a few months to a year. Observations of the winter chilled plants showed that, with the exception of high altitude plants, the time of the breaking of dormancy and the time of the onset of dormancy were inversely correlated to the latitude of origin.

WARBURTON, DOROTHY. Factors in the Etiology of Spontaneous Abortions. *Department of Genetics, McGill University, Montreal, Canada.*

This study is based on data from the Family History files of the Department of Medical Genetics at the Montreal Children's Hospital. The purposes of the study are: (1) to make explicit the numerous sources of bias to which data collected on human spontaneous abortions are subject, and to assess their importance; (2) to seek correlations which might elucidate some etiological factors in spontaneous abortions.

Some of the factors available for analysis are racial origin, maternal and paternal age, consanguinity, birth order, maternal menstrual history and previous reproductive history. The analysis of some of these is still in progress at the time of writing. So far it can be reported that abortion frequency is positively correlated with increasing maternal age and also with the number of live premature births. No relation has been found with racial origin, consanguinity, irregularity of the mother's menstrual cycle or the number of stillbirths in her reproductive history. Also, the frequency of abortion in families ascertained through a child with cleft lip or palate is significantly lower than in control families ascertained through a child without this defect. The relationship between abortion frequency and other malformations will also be investigated.

WARBURTON, FREDERICK E. Natural Selection as the Accumulation of Information from the Environment. *McGill University, Montreal, Canada.*

Shannon's mathematical theory of communication allows us to treat the gene complement of an organism as a "message." The information conveyed by the message to its recipient—in this case, to the developing organism—is (in binary digits):

$$H = \log_2 \frac{\text{probability of certain events after receipt of message}}{\text{probability of same events if message were not received}}.$$

In evolution, the information content of genomes has tended to increase. Mutation and drift can be shown to lead to loss of genetic information. The large information content of genomes must therefore have been accumulated by natural selection. The rate of accumulation, in binary digits/locus/generation could be calculated for a given population if mutation rates and variations in gene frequencies from generation to generation were known with sufficient accuracy; such calculations may be feasible within a decade.

By natural selection, the environment determines which genotypes will be transmitted to future generations; i.e., the original source of genetic information is the environment. Natural selection can therefore be considered as a mechanism by which populations accumulate information from their environments.

WATANABE, MICHIKO. *See* WATANABE, TSUTOMU.

WATANABE, TSUTOMU, and MICHIKO WATANABE. Transduction of Streptomycin Resistance in *Salmonella typhimurium. Department of Zoology, Columbia University, New York, N.Y., U.S.A.*

Although Zinder and Lederberg (1952) reported on the transduction of streptomycin resistance in *Salmonella typhimurium*, several workers have been unable to reproduce their transduction experiments on resistance to streptomycin as well as to other drugs. We have recently succeeded in transducing both streptomycin indifference (one-step complete resistance) and resistance in the narrow sense (multiple-step resistance) using *Salmonella typhimurium* strain LT-2 and temperate phage P-22.

Transduction of indifference was found to require one to three generations for phenotypic expression. This lag may involve a segregation delay if the indifference locus is recessive in this strain. Phenomic lag is also assumed to play a role because transduction of indifference is phenotypically expressed gradually from partial to complete resistance, despite the fact that there is much evidence for the control of indifference by a single gene.

Transduction of intermediate resistance into sensitive bacteria does not give clear-cut positive results. The reason for this is unknown at present. The fact, however, that the second step of resistance may be transduced into one-step resistant bacteria suggests that the difficulty is merely technical. Furthermore, the substitution by transduction of the wild-type allele at the resistance locus was found to occur very easily with the following technique. Because resistant mutants are slow growers, it is easy to detect the fast-growing transductants on the poor background growth of the resistant recipient on agar plates without streptomycin. In transductions with one-step intermediate resistant mutants as recipients, the fast-growing transductants were found to be streptomycin sensitive. With this technique, it has become possible to cross resistance with sensitivity, resistance, and indifference. A number of independently isolated one-step and two-step resistant mutants have been analysed and many loci which control streptomycin resistance have been found. Linkage of streptomycin loci to other markers is also under study.

WATT, DEAN D., and H. WARNER KLOEPFER. Separation of Blood Proteins by Starch Gel Electrophoresis. *Southeast Louisiana Hospital, Tulane University, Mandeville, La., U.S.A.*

Smithies (Biochem. J. *61*: 629–641) developed a better method (zone electrophoresis in starch gels) for the resolution of alpha-beta globulins than had been obtained by other techniques. He found that certain electrophoretic patterns which were characteristic for the individual were controlled by genes.

The present study of electrophoretic patterns by the starch gel techniques was initiated in individuals of a large kindred in which a dominant gene for a pre-senile dementia was segregating. This study which was designed to learn more about the inheritance of serum proteins was facilitated by the development of a four-channel electrophoretic cell with separate electrical controls which will supply a constant current of 5.0 ± 0.1 milliamps. Samples of serum are run with the additions of hemoglobin (1.46 mg./ml.) and without the addition of hemoglobin.

Characteristic bands may be identified either by staining with amido-schwarz or by testing for the peroxidase activity of hemoglobin by the hydrogen peroxide-benzidin reaction. Serum proteins which bind hemoglobin seem to characterize the group of variations reported by Smithies. The techniques used in the present study and some of the results obtained will be discussed.

(This investigation was supported in part by a research grant, #B-962 (C2), from the National Institute of Neurological Diseases and Blindness of the National Institutes of Health, Public Health Service.)

WEAVER, GERALD, M. *See* HOUGH, L. FREDERIC.

Weeth, H. J. *See* Kidwell, J. F.

Weijer, Jan. Evidence for a Complex Structure of the *td*-locus in *Neurospora crassa. Department of Plant Science, University of Alberta, Edmonton, Alta., Canada.*

Yanofsky's studies (1952, 1953) strongly suggested that the *td*-locus in *N. crassa* represents a complex structure consisting of several closely linked alleles. These alleles behave differently although they are alleles from a biochemical point of view since all are characterized by a lack of the enzyme tryptophan synthetase. The genetic analysis of these strains (Weijer, 1954) showed that several of the tryptophan independent recombinants recovered from intra-mutant crosses could not have originated from crossing-over within the *td*-locus, and hence genetic evidence for a complex structure of the *td*-locus could not be produced. In recent studies, several spontaneous *td*-mutants and one UV *td*-mutant (at low energy level) were obtained, all characterized by a tryptophan requirement which cannot be satisfied by indole. As a test of biochemical identity, heterocaryons between these strains could only be established in the presence of tryptophan. In six intra-mutant crosses using "fluffy" as a marker in one of the parental strains, tryptophan independent isolates were recovered from combinations involving *td*-UA2, *td*-UA5 and *td*-UA6. None of these strains produced tryptophan independent recombinants by selfing. The germination percentage of the ascospores in all the crosses was considerably higher (approximately 90%) than in previous experiments (50%). The results indicate that several closely linked genes are present within the *td*-locus, all of which must be present in the same linkage group for expression of the *td*-locus in tryptophan formation.

Weinstein, Alexander. Did Nägeli Fail to Understand Mendel's Work? *Biological Laboratories, Harvard University, Cambridge, Massachusetts, U.S.A.*

(See Appendix.)

Weir, J. A., and H. G. Wolfe. Modifications of the Sex-Ratio of Mice through Genetic and Environmental Causes. *University of Kansas, Lawrence, Kan., U.S.A.*

Selection for blood-pH, with inbreeding, has given rise to a high blood-pH line of mice, pHH (7.476 ± .004) and a low line, pHL (7.426 ± .004). Concomitant shifts in sex ratio (pHH 55% ♂♂, pHL 45% ♂♂ cf. outbred T foundation stock 50% ♂♂) are permanent characteristics of the strains. Results from reciprocal crosses and artificial inseminations have established that the sex ratio is a function of sperm source. Sex ratios at third trimester and among stillborn mice do not differ significantly from the sex ratio of living mice at birth or weaning. Starting with descendants from the original outbred line, T, we are repeating the selection experiment, but with minimal inbreeding, and using arterial instead of venous blood. Results from three generations of selection are as follows: S_1 high line, blood-pH 7.52 ± .007, sex ratio 48.3% ♂♂; low line, blood-pH 7.49 ± .007, sex ratio 57.6% ♂♂. S_2 high line, 7.56 ± .005, 47.3% ♂♂; low line 7.53 ± .005, 55.3% ♂♂. S_3 high line, 7.56 ± .005, 45.9% ♂♂; low line 7.51 ± .005, 50.0% ♂♂. Outbred mice contemporaneous with S_3 had blood-pH 7.53 ± .006, sex ratio 47.4% ♂♂. Significant changes in blood-pH of ♂♂ from inbred pHH and pHL strains, in the expected direction, have been produced by feeding acid and alkaline diets, but litters sired by treated males include significantly fewer male progeny, in each case, compared to sex ratios of litters from males on neutral diet. Although significant shifts in sex ratio result from changes in blood-pH brought about either by genetic or by non-genetic influences, the relationship is complex.

Welsh, J. N., and G. J. Green. Genes in Oats for Resistance to Stem Rust Races and the Genetics of Host Reaction. *Cereal Breeding Laboratory and Plant Pathology Laboratory, University of Manitoba, Winnipeg, Man., Canada.*

At the present time fifteen races of oat stem rust, *Puccinia graminis* Pers. f. sp. *avenae* Erikss. and Henn., have been identified on the North American continent. Four major genes (A, B, D, E) and probably a fifth (C) govern resistance to certain groups of these races. Gene A, possessed by the variety Richland, governs resistance to races 1, 2, 3, 5, 7, 7A, and 12. This is sometimes referred to as the Richland gene although a number of other varieties have the same resistance. Resistance to races 1, 2, 3, 5, 7, 12 and to races 4, 6, 8, 10, 11, 13, possessed by Hajira and its derivatives, is thought to be governed either by two closely linked genes, B and C, respectively, or by the B gene alone. In the United States this is referred to as the "Canadian factor" for resistance. Gene D, possessed by White Russian and its derivatives, governs resistance to races 1, 2, 5, 8, 8A, 10, 11, and gene E, possessed by Jostrain and its derivatives, confers resistance to races 1, 3, 4, 11 and partial resistance to races 5, 10, 12, 13 and 13A. Races 8A and 13A were isolated in Canada for the first time in 1957.

Results with several oat crosses confirm the existence of genes A, B, D and E, but throw some doubt on the existence of gene C. The crosses studied are as follows: Garry (ABC) × R.L. 231 (susc.); Garry (ABC) × Roxton (E); R.L. 1225 (BC) × Ajax (A); Canuck (BCE) × Victory (susc.); and Canuck (BCE) × Cherokee (D).

Welshons, W. J. Pseudoallelic Recessive Lethals at the *Notch* Locus of *Drosophila melanogaster. Biology Division, Oak Ridge National Laboratory, Oak Ridge, Tenn., U.S.A.*

The linear arrangement from left to right on the X-chromosome of three recessive visible mutants at the *Notch* locus has been established as follows: facet (*fa*), facet-notchoid (fa^{no}), and split (*spl*). Furthermore, experiments have indicated that the dominant *Notch* (*N*) mutants plus the recessive visibles constitute a pseudoallelic array similar to the star-asteroid and ultrabithorax-bithoraxoid series described by Lewis (1951). However, the Notch pseudoallelic array differs from the others in one important respect: there are at least three different sites capable of mutating to Notch, a recessive lethal condition, whereas in the other series only one member of the array is such a mutant. Since Notches are sex-linked recessive lethals, this complex locus carries a pseudoallelic recessive lethal series and a recessive visible pseudoallelic array. The pseudoallelism of the Notch mutants was established on the basis of experiments outlined below.

N^{264-40}/spl and N^{Co}/spl heterozygotes, which also carried other appropriate markers, yielded spl^{+} N^{+} chromosomes; the majority of these were associated with recombination. If they arose by a cross-over between Notch and split, N^{264-40} had to be to the left of *spl* and N^{Co} to the right of *spl*. The following experiment supports this interpretation. Females which were $y\ w^{a}\ N^{264-40} + + / + w^{a} + N^{Co}\ rb$ yielded, by recombination between the two Notches, 13 chromosomes out of approximately 75,000 which were of the expected $+\ w^{a} + + +$ type (a small duplication carried by an autosome covers the lethality of the Notch combination). Additional experiments have identified another site, making a total of at least three, capable of mutating to Notch.

Thus, the Notches constitute the first pseudoallelic recessive lethals in *Drosophila.*

WETTSTEIN, DITER H. VON. Directed Mutability and Submicroscopic Gene Physiology in Chlorophyll Lethals. *Genetics Department, Forest Research Institute and Genetics Institute of the University, Stockholm, Sweden.*

Chlorophyll lethals in a self-fertilizing species such as barley are used as tools in the study of the mutation process in two ways: (1) as a test for the efficiency and quality of a mutagen; (2) for the genetic control of plastid development.

(1) The mutant spectra obtained after treatment with ionizing radiations and chemicals reveal considerable quantitative and qualitative differences in the action of mutagens. By applying chemicals we can differentiate between gene mutations and chromosomal rearrangements. Moreover, the mutation process can be concentrated at certain loci and chromosome breakage can be preferentially achieved in heterochromatic regions and other special structures of the chromosome.

(2) The nature of chlorophyll or plastid defects caused by gene mutations can be analysed by means of recently developed electronmicroscopic techniques. In the lethals investigated so far the synthesis of the lamellar structure in the chloroplasts is blocked at various stages, whereas the plastid growth as a whole is little or not at all affected. Examples will be given of certain genes controlling the formation of extended submicroscopic layers from smaller units. As a consequence of the blockage, structures of macromolecular size accumulate in certain mutants. Parallel chemical analysis enables us to isolate substances which might be contained in the observed submicroscopic structures. Plastids seem to be excellent material for studying the action of genes on the structural organization at a macromolecular level.

WHITEHOUSE, H. L. K. Patterns of Interference between Cross-overs in *Neurospora. Botany School, University of Cambridge, Cambridge, England.*

Analysis of asci segregating at four loosely linked loci (mating-type, *me* (35809), *al*-2, *nic*-1) in the mating-type chromosome of *Neurospora crassa* is in progress, with the object of obtaining information about the broad pattern of interference between cross-overs. Preliminary results are as follows. Across the centromere there appears to be negative position interference and an excess of two-strand relationships. This is similar to the findings of Lindegren and Lindegren (Genetics *27*:

1–14) and Rifaat (Ph.D. thesis, Cambridge, 1956), and contrary to the results of Howe (Genetics *41*: 610–622) and Stadler (Genetics *41*: 623–630), who found no position or chromatid interference. Thus there appears to be heterogeneity in the patterns of interference across the centromere in different strains of *Neurospora*. In the proximal part of the right arm of the mating-type chromosome, the results indicate positive position interference and an excess of four-strand relationships. Similar though hardly significant results were found by Lindegren and Lindegren (*ibid.*). In the distal part of the right arm, there again appears to be positive position interference but no chromatid interference. This is similar to the results of Lindegren and Lindegren (Genetics *24*: 1–7) for another *Neurospora* chromosome.

Pritchard (Heredity *9*: 343–371) suggested that in *Aspergillus* crossing-over is confined to regions of "effective" pairing within which there is negative position interference, while the regions of effective pairing show positive interference with one another. A tentative explanation of the diversity in the patterns of interference in *Neurospora* would be to extend Pritchard's hypothesis and postulate that within regions of effective pairing only two-strand relationships occur between cross-overs, while between one such region and another, other strand-relationships are possible, perhaps as a consequence of delayed duplication of chromatids in the intervening regions. In some strains of *Neurospora*, one of the regions of effective pairing is presumed often to include the centromere.

Whiting, P. W., and Sarah B. Caspari. Factor Homologies in Mutant *R* Genes of *Mormoniella. Department of Zoology, University of Pennsylvania, Philadelphia, Pa., U.S.A.*

Mutant genes in this series are unifactorial, bifactorial or trifactorial according to the number of factors affected by the mutation. The states or conditions of factors form subseries of homologous alternatives within the series of allelic genes. Homology is determined by the traits of the compound females. Thus for the 4 known eye-color factors *O*, *S*, *M* and *N*, the compound *o.s.+.n/+.+.m.+* is wild type and *+.s.m.+/+.+.m.+* is mutant type. Eye colors determined by the various combinations in the 4 subseries serve as markers for sterility or lethal factors. Thus wild-type female *+.da.la.+/oy.+.+.fsx* crossed to oyster male *oy.st.fsa.+* produces sterile dahlia and fertile oyster daughters and fertile (female-sterile) oyster sons. Dahlia, *da*, is homologous with scarlet, *st*, and dominant. Female-sterile-a, *fsa*, is dominant over lethal-a, *la*, the two being alternative mutant conditions of factor *A*, but it is complementary with female-sterile-x, *fsx*, each condition being recessive to its normal alternative in the allelic gene. Sterility of compounds for different mutant genes bearing lethals with an *fsa* gene indicate that the lethals are homologous, affecting factor *A*. It has not hitherto been possible to test homology of two different lethals or of male-steriles directly because they could not be brought into the same cross. It now seems likely that this may be done on the diplo-triploid level. Diploid males have been crossed to females carrying a lethal. The daughters (triploid) with the lethal produce diploid sons, some of which are lethal-bearing. These are now being crossed to females with a different lethal. Half the triploid daughters should have both lethals and some of the diploid sons of these triploids should have both lethals unless the lethals are homologous. Failure to get males with both lethals will indicate their homology. (Work done under U. S. Atomic Energy Commission Contract AT(30-1)-1471.)

WHITING, P. W., GEORGE B. SAUL, 2ND, and DAVID T. RAY. *Mormoniella* and *Sarcophaga, University of Pennsylvania, Philadelphia, Pa.*; *Dartmouth College, Hanover, N.H.*; *Howard University, Washington, D.C., U.S.A.*

A demonstration will be given showing the mutant types of the chalcidoid wasp *Mormoniella vitripennis* (Walker) with living and preserved material. Charts showing methods of heredity, linkage maps and factorial formulae of genes will also be presented. The life history of the wasp including diapause larvae will be discussed.

Material on the blowfly *Sarcophaga bullata* Parker, including a discussion of its life history (living and preserved material), method of rearing and the parasitism of *Mormoniella*, will also be presented.

WHITTINGHILL, M., EVELYN E. HENDRICKS, GERVAS S. TAYLOR, JR., and LEWIS S. THORP. The Distribution of Rheumatoid Arthritis, Spondylitis and Multiple Rheumatoid Arthritis in a Single Large Kindred. *University of North Carolina, Chapel Hill, N.C., U.S.A.*

In a single kindred of some 3,000 persons it was found that cases of rheumatoid arthritis were distributed independently of spondylitis and multiple rheumatoid arthritis. Starting within the kindred from 28 rheumatoid arthritis cases additional cases of the same disease were found with higher incidence the closer the genetic relationship: one genetic step away, 3.7 ± 1.14%; at two genetic steps 2.4 ± 0.64%; at three genetic steps, 2.3 ± 0.60%; and only 9 of the 28 rheumatoids had no affected relative in this close a relationship. This pattern suggests a weak influence of heredity. The kindred was so extensive that the over-all incidence, 28/3,000, was as low as in a control area, where 3 rheumatoid cases and none of the other 2 were found among 337 persons. Among the 1,463 (overlapping) close relatives of rheumatoid arthritis cases there were only 2 cases of spondylitis. This was less than was to be expected for a random rather than a familial distribution; and, conversely, these same 2 pairs of relatives were fewer than chance expectation for rheumatoid arthritics among the total of 587 persons who were close relatives of the 10 spondylitics or of the 5 people with multiple rheumatoid arthritis. The spondylitics had higher than random frequencies of other spondylitics and of cases of multiple rheumatoid arthritis among their close relatives in a pattern suggesting a genetic foundation for this dual susceptibility. At one, two and three genetic steps removed the incidences were 6.3 ± 2.48, 2.9 ± 1.16, and 0.7 ± 0.5%, respectively. The 5 people with multiple rheumatoid arthritis had as close relatives people with spondylitis rather than with other forms of juvenile or adult peripheral arthritis, even though all 43 cases were remotely related. Although the genetic basis acts weakly, it seems to differentiate a tendency to multiple rheumatoid arthritis and to spondylitis in children and youths as one genetic entity, which is separate from an inherited tendency to rheumatoid arthritis at later years.

(This work was aided in part by research grants A-26 and A-53 from the National Institute of Arthritis and Metabolic Diseases, U. S. Department of Health, Education and Welfare, and by C-136 from the Carnegie Research Fund of the University of North Carolina.)

WILCZYNSKI, JAN Z. Orthogenesis as a Genetical Problem. *Lebanese State University, Beirut, Lebanon.*

Refuting the autogenic and selectional explanations of the phenomena of orthogenesis, the author seeks to explain them by microevolutionary processes, and so provide a possible, though restricted, solution in terms of the mechanisms of hereditary transmission. Since analysis and confirmation of his theory from the point of view of population genetics is not yet possible, he limits himself to the genotypical analysis of expected sequences of produced zygotes as individualized entities.

The author's argument is based on the general equation of Mendel's Law in their genotypical representation, developed by him in 1938–51 as an expansion of a binomial formula: $P_{\blacktriangle}\, 2^m\, 2^{n-m}$, where $P_{\triangle}$ is Pascal's arithmetic triangle, m is a series of natural numbers, and n is an allelic power of any crossing. In this expression the zygotes are presented by particular and different terms with regard to both their genotypical components and their respective frequencies. The phenomena of orthogenesis would then correspond to the terms giving the fullest and strongest integration of the features (genes) concerned, together with their greatest frequencies. Since these will tend to be perpetuated through the generations, such organisms ought to acquire ever greater chances of survival by securing stronger expression and more prolific reproduction with each succeeding generation, which may result in apparent orthoselection.

His point of view is discussed with examples taken from studies of polypoidy, of polymerism, of gene interactions and heterosis, of gradual chemical complication in the physiology of digestion and growth, and of the phenomena of mimicry and of biogeographic variability. He considers the possibility of applying to all of these examples the genotypic interpretation of orthogenesis.

WILKINSON, CHAS. F., Jr. *See* HIRSCHHORN, KURT.

WILLIAMS, L. F. Alteration of Dominance and Apparent Change in Direction of Gene Action by a Mutation at Another Locus Affecting the Pigmentation of the Seedcoat of the Soybean. *U.S. Department of Agriculture,* and *Department of Field Crops, University of Missouri, Columbia, Mo., U.S.A.*

Major pigmentation patterns of the seedcoat of the soybean are controlled by a series of alleles at the *I* locus. On a *TR* background (tawny pubescence, black pigment), the effects of these alleles, arranged in decreasing order of dominance, are as follows: *I*, pale slate hilum, coat yellow or green; i^i, black hilum, seedcoat yellow or green; i^k, hilum and saddle black, remainder brown; *i* self black. Ordinarily, dominance is complete.

In two mutants from i^i types, the hilum and saddle are black with the remainder yellow or green. This is a result of a recessive mutation at the *K* locus, the effect of *k* being to increase pigmentation. However, the other three *I* alleles, which have very distinct effects on a *K* background, have identical phenotypes in combination with *k*. The homozygous types are all self black and the i^i heterozygotes have an extended saddle closer to self black.

The *l* allele is affected most. In combination with *K*, *l* seems to have a strong inhibitory effect, but with *k* it seems to have an enhancing effect. This change in dominance and in type of allele action is difficult to explain. A suggested explanation is that *l* rather than inhibiting pigment, merely has a very weak enhancing effect and *k* is thus able to affect pigmentation.

WILLIAMS, WATKIN. The Manifold Effects of Major Genes in Relation to Economic Characters in Plants. *John Innes Horticultural Institution, Hertford, England.*

Studies of the genetic control of flower number in genotypes homozygous for the suppressed lateral gene *ls* will be described. The analysis of F_2 families segregating for recessive marker genes showed that when the marker was present in the homozygous recessive condition the effect of *ls* in reducing flower number was intensified. The most pronounced effect was produced by interaction between *ls* and *dm* (linkage group IX) and *ls* and *l* (linkage group VI). The only interactions which effected an increase in flower number above *ls ls* + + were *ls ls a a* (linkage V) and *ls ls y y* (linkage group III). None of the ten markers proved completely neutral in respect of flower number when combined with *ls*. When scored singly the major gene markers differed insignificantly from the dominant wild type except in the genotypes *wt wt* and *b b* where a significant increase over the wild type was demonstrated.

Data in respect of four loci in *Prunus persica* and *Prunus avium* will also be briefly presented. The neutrality of major genes in respect of character expression will be discussed, and their importance in plant breeding assessed.

WILLIAMS, WATKIN, and G. J. DOWRICK. The Induction of Mutations in Plants Using Radio-active Phosphorus (P^{32}). *John Innes Horticultural Institution, Hertford, England.*

The mutagenic effect of P^{32} on three plants—the apple, tomato and foxglove (*Digitalis purpurea*)—has been studied at the John Innes Horticultural Institution. Different methods of administration were compared and it was found that injection of the P^{32} was most satisfactory. The distribution of radio-activity in various parts of the plants was measured and the biological half-life of the isotope was found to be substantially less than its physical half-life owing to the exudation from the roots into the soil.

In the apple the efficiency of the dose is directly related to the number of active buds. At higher bud numbers a higher proportion of the injected dose was recovered in the growing points. Thus the same specific activity can be obtained in a tree with 96 buds, as compared with a tree with 12 buds simply by doubling the dose administered.

The upper level of tolerance of the vegetative buds of the apple was found to be $50\mu C$/gm. dry weight. This corresponds to a dose of 44,500 rep. assuming total absorption of the particles. If the absorption is 50% and the biological half-life is half the physical life, the calculated dose at the upper tolerance limits will be reduced to 11,000 rep.

Mutant phenotypes identical with those existing in wild populations have been recovered. However, mutant plants may be characterized by differences in growth rates as compared with both the wild type and the naturally occurring mutants. Evidence is presented which indicates that the variability of complex quantitative characters is increased in irradiated material and that selection for maximum character expression is therefore made more effective.

WILLIAMSON, D. L. Observations on Carbon Dioxide Sensitivity in the *Drosophila affinis* Subgroup. *University of Nebraska, Lincoln, Neb., U.S.A.*

Carbon dioxide sensitivity (death in CO_2 at 13°C) has been found in wild-caught *Drosophila affinis* and *athabasca*, and also in laboratory strains of *affinis*, *athabasca*, and *tolteca*.

D. affinis collected in Nebraska during the summer of 1957 exhibited 25% sensitivity, and *athabasca* collected in Alaska during July and August, 1957, showed 8.5% sensitivity.

A laboratory strain of *affinis* from Nebraska was found to be nearly 80% sensitive, and a strain of *athabasca* from Alaska was 99% sensitive. In addition, laboratory strains of *tolteca* from Nicaragua and Mexico were found to exhibit 5% and 8% sensitivity respectively.

Reciprocal matings involving the sensitive *athabasca* strain and a resistant strain of this species have indicated that the sensitivity is maternally inherited.

WILLWEBER, EN. *See* YAMASHITA, KOSUKE.

WILSON, G. B., A. H. SPARROW, and VIRGINIA POND. Radiation-Induced Sub-Chromatid Breakage and Rejoining during Meiosis of *Trillium erectum* L. *Brookhaven National Laboratory, Upton, Long Island, N.Y.*, and *Michigan State University, U.S.A.*

Anthers of *Trillium erectum* were X-irradiated with 25 r at various stages of meiotic prophase and at the first metaphase. Analysis of the aberrations at the first and second anaphases revealed that pre-diplotene treatment did not and that post-pachytene irradiation did produce configurations (2-side-arm bridges) indicative of half-chromatid exchanges. The occurrence of these bridges and knowledge of the structure and spatial relationship of chromatid strands in *Trillium* have led to certain conclusions regarding (1) the target and (2) the number of sub-chromatid strands broken by a single event. (1) The most likely targets for primary effects are the four associated half-chromatids of a half-bivalent. The irradiation results suggest that the half-bivalent becomes effectively as well as structurally quadripartite at stages following pachytene. (2) Consideration of the configuration which would result from breakage and rejoining of two-, three- or all four-strands of the half-bivalent indicates that only two of the four half-chromatids are broken by a single event, i.e., a single ionization track. Exchanges between these two half-chromatids will produce two recognizable types of 2-side-arm bridges: one with a true dicentric half-chromatid and one in which the bridge results from an interlocking of coils. Whether a 2-side-arm bridge will appear at first or second meiotic anaphase is determined by the position and number of chiasmata between the point of breakage and the kinetochore. So far no 2-side-arm bridges have been detected at microspore anaphase from meiotic prophase irradiation. The types of configurations which might be expected at microspore metaphase as a result of broken 2-side-arm bridges have been observed but at a very low frequency. (Research carried out at Brookhaven National Laboratory under the auspices of the U.S. Atomic Energy Commission.)

WOLF, B. ERICH. Control of the Crossing-Over Frequency in the X-Chromosome of *Phryne cincta* by Allocycly (Diptera: Nematocera). *Institut für Genetik der Freien Universität Berlin, Berlin, Germany.*

A remarkable correlation between a genetic feature and the allocyclic behaviour of the X-chromosome in *Phryne cincta* has been discovered.

As to the allocyclic behaviour of the X-chromosome, the giant chromosomes of *Phryne cincta* ($n = 3 + X(Y)$) from larvae raised at different temperatures have been studied (Wolf, Chromosoma *8*: 396). The X-chromosome is characterized by a considerable range of temperature-dependent variability in shape and structure, caused by its allocycly. Under ordinary room-temperature conditions it is a flat granular body, broader but relatively much shorter than the autosomes. At low temperature it grows to normal length, assuming the aspect of a normal giant chromosome. The temperature-conditioned variability of the X is a new expression of its allocycly, previously observed only in mitosis and meiosis.

As to the genetic behaviour of the X-chromosome, a considerable range of temperature-dependent variability in the frequency of a localized crossing-over, correlated with the allocyclic behaviour of the X in somatic cells, could be demonstrated. For this purpose female animals—heterozygous for several structural rearrangements in their X-chromosomes and raised either at high (20–26°C) or at low (2–8°C) temperatures— were mated with males of a definite race. The female progeny of 19 single pairs were tested by analysis of their giant chromosomes. Besides the expected types of X-chromosomes there were found two complementary types of recombination caused by a strictly localized crossing-over between the starting types. In all 1,432 X-chromosomes have been tested. Only a small rate of crossing-over or none at all was found (mean 3.2%) in the "warm-raised" hybrids in contrast to their "cold-raised" sisters who showed a high frequency (mean 21.15%).

The conditions causing the structural modification of the X-chromosome in somatic cells are evidently the same as those which cause the variation in the frequency of the localized crossing-over.

WOLFE, H. G. *See* WEIR, J. A.

WOLFF, GEORGE L., and BERTON F. HILL Impact of a National Cancer Chemotherapy Screening Program on Mammalian Genetics in the U.S.A. *National Cancer Institute, N.I.H., U.S. Dept. of Health, Education and Welfare, Bethesda, Maryland,* and *Institute of Laboratory Animal Resources, National Academy of Sciences, Washington, D.C., U.S.A.*

One million (C57BL/6 × DBA/2)F_1 hybrid mice per year are needed by the screening program for anti-cancer substances of the Cancer Chemotherapy National

Service Center (National Cancer Institute, U. S. Public Health Service). This unprecedented demand for mice of a specific genotype provided the stimulus for the development of several national programs in the areas of mammalian genetics and laboratory animal production.

A set of "Minimum Standards for the Commercial Production of Randombred and Inbred Laboratory Mice" (J. Nat. Cancer Inst. *19*(6): 1137–1143) was developed by the Institute of Laboratory Animal Resources (National Academy of Sciences) under a contract with the Cancer Chemotherapy National Service Center. These "Minimum Standards" are serving as the basis for the accreditation of commercial mouse producers in the U.S.A.

Several commercial breeders were chosen on the basis of technical competence, compliance with the "Minimum Standards," and geographic location to receive C57BL/6 females and DBA/2 males from the Jackson Memorial Laboratory on a replacement basis for the production of a large part of the one million (C57BL/6 × DBA/2)F_1 hybrids.

With the assistance of grants-in-aid and research contracts from the National Cancer Institute of the U. S. Public Health Service, centers for training and research in mammalian genetics have been established at the Universities of Kansas, Miami, and Michigan. The inbred mouse colonies at these centers will also provide insurance stocks of inbred mouse strains available in case of disaster at one or more of the mammalian genetics centers, including the Jackson Memorial Laboratory. In addition any large-scale future needs for inbred or F_1 hybrid mice of specific genotypes can be met more expeditiously by the establishment of additional "satellite breeders" receiving breeding stock on a replacement basis for one or more of the mammalian genetics centers.

WOLFF, SHELDON. Protein Synthesis and Chromosome Break Rejoining. *Biology Division, Oak Ridge National Laboratory, Oak Ridge, Tenn., U.S.A.*

If the dose of radiation administered to the soaked seed of *Vicia faba* is fractionated, the frequency of chromosome exchanges induced will vary according to the fractionation time. If the breaks from the first dose have not rejoined before the second dose is administered, the aberration yield will be the same as it would have been if the dose had not been fractionated (proportional to the square of the total dose). If the breaks from the first dose have rejoined completely before the second dose, then the yield will be the sum of the yields of the partial doses. Previous experiments have shown that the rejoining of the breaks is not a passive process, that cellular metabolism and the production of ATP is necessary for breaks to rejoin, and that the breaks are of covalent bonds.

In order to elucidate the mechanism of rejoining, a dose fractionation study was performed in which the breaks from the first dose would rejoin in one-half hour. Immediately after this first dose, the seeds were treated with 300 μg./ml. of chloramphenicol to inhibit protein synthesis. The breaks then did not rejoin but remained open for at least seventy-five minutes as determined by the aberration yield when a second dose was administered seventy-five minutes after the first.

The results of these experiments constitute presumptive evidence that protein synthesis is necessary for the rejoining of radiation-induced chromosome breaks. As yet it has not been determined if the bonds synthesized during rejoining are peptide bonds or if protein synthesis acts more remotely in the repair of damage to a postulated "rejoining system."

WOLSKY, ALEXANDER. The Metabolic Basis of Some Gene-Controlled Characters in *Drosophila* and *Mormoniella*. *Biological Laboratory, Fordham University, New York, N.Y., U.S.A.*

Three gene-controlled character pairs of *Drosophila melanogaster* and one of the parasitic chalcid wasp *Mormoniella vitripennis* will be considered. "Ebony" of *D. melanogaster* differs from its wild-type allele in darker imaginal integument and paler (and softer) puparium. On the basis of earlier investigations of the author and others (Csik, Dennell, Fabian, Ohnishi) and unpublished new results, an attempt will be made to correlate the differences in enzyme activity (dehydrogenases, tyrosinase). A sex-linked genetic mechanism (discovered in an inbred population from Java), which is not yet fully clarified, affects the number and arrangement of interocellar bristles (Mulrennan). Its expressivity can be modified by reducing the food supply of the larva and this together with other evidence indicates that the gene or genes involved affect metabolic processes. Eye color in *D. melanogaster* is known to depend on genes which are closely associated with enzyme reactions, leading to the formation of red and brown pigments. Experiments show that these reactions are not specifically inhibited by the characteristic poison of the cytochrome oxidase system, carbon monoxide. On the other hand, in *Mormoniella* the formation of the brown eye pigment is specifically inhibited by carbon monoxide (Rohner) and treatment with a carbon monoxide–oxygen mixture during metamorphosis results in specimens with red eyes, which are phenocopies of the "scarlet" mutation described by Whiting. Thus the metabolic basis of eye pigment formation is different in the two species.

WOODS, PHILIP S., and J. H. TAYLOR. Nucleic Acid Synthesis in Dividing Cells. *Brookhaven National Laboratory, Upton, N.Y., U.S.A.*

The metabolism of RNA and DNA in dividing cells has been studied by autoradiograph tracer techniques. Seedlings of *Vicia faba* were grown on nutrient solutions containing tritium-labelled cytidine a precursor of RNA and DNA; and at intervals up to 8 hours roots were fixed, and sections were covered with autoradiograph stripping film.

Autoradiographs showed that incorporation of the labelled precursor took place first in the nucleolus and later in the cytoplasm. Radioactivity in the chromatin of nuclei was variable; some nuclei showed strong autoradiographs, others showed weak or no autoradiographs.

From a separate chromatographic study using non-labelled roots, it was found that no RNA or DNA was lost prior to attachment of the photographic emulsion to the sections. RNA could be quantitatively removed from sections without loss of DNA. Upon using these procedures on H^3-labelled roots, it was found that radioactivity in the chromatin of nuclei was due largely to incorporation into DNA. Radioactivity in other parts of the cell was due to incorporation into RNA.

To determine whether the H^3-cytidine was incorporated in both the nucleolus and cytoplasm either with or without turnover, or was incorporated largely in the nucleolus and later transferred as a large molecule to the cytoplasm, other seedlings were treated with H^3-cytidine long enough that only nucleoli were labelled and then were removed and grown on a non-labelled solution containing an excess of cytidine and uradine. Autoradiographs showed a decline in radioactivity in nucleoli and a rise in the cytoplasm with increased post-treatment time.

The nucleolus either is the only site of RNA synthesis in the cell, or is concerned with accumulating RNA that has been synthesized elsewhere, but the synthesis time is very short. RNA as a large molecule is then transferred to the cytoplasm. DNA and RNA synthesis are independent processes.

WOODWARD, D. O. Heterocaryon Complementation between Adenylosuccinaseless Mutants of *Neurospora crassa. Botany Department, Yale University, New Haven, Conn., U.S.A.*

Thirty-five adenine-requiring adenylosuccinaseless mutants at the *ad-4* locus of *Neurospora crassa* have been tested for heterocaryon complementation in all possible pair combinations. Fourteen of the thirty-five mutants gave at least one positive response. In all cases tested in which complementation occurs, partial restoration of adenylosuccinase activity has resulted. Enzyme activities of the crude mycelial extracts (tested by following the splitting reaction of adenosine monophosphate succinate to adenylic acid in a recording spectrophotometer) range from 3% to 30% of that found in the parental wild type strain, 74A. Based on the complementation pattern, it has been possible to arrange these *ad-4* alleles in a linear sequence. This can be done because of apparent overlap between non-functional regions characteristic of the individual alleles. Meiotic recombination occurs between some of the alleles, giving rise to wild-type progeny. Based on the complementation pattern, these appear to be the more widely separated alleles of the linear sequence. Furthermore, the order of the alleles deduced from such crosses utilizing linked markers on either side of the locus does not conflict with the order based on the heterocaryon tests. To date, infertility in many of the crosses has made a complete recombinational analysis impossible. Certain heterocaryons are temperature sensitive in that they exhibit essentially wild-type growth at 25°C and little or no growth at 35°C. There is some indication of a specific region or regions within the locus affecting temperature sensitivity. (Supported in part under a contract AT(30–1)–872 with the U.S. Atomic Energy Commission.)

WOODWARD, V. W. *See* MUNKRES, K. D.

WOODWARD, VAL W., YOSHITAKA SUYAMA, and K. D. MUNKRES. New Loci Affecting Pyrimidine Metabolism in *Neurospora. Kansas State College, Manhattan, Kan., U.S.A.*

From over one hundred pyrimidine-requiring mutants of *Neurospora crassa*, recently isolated in our laboratory, at least two are genetically and physiologically distinct from any reported to date. In an earlier publication, a fifth locus involved in pyrimidine biosynthesis was implied, but the evidence was equivocal. It is now evident that the earlier implication was based on the phenotype of a double mutant, KS-12. Mutant KS-12 is physiologically similar to pyr-3 (37301), but is genetically dissimilar. On crossing, it gives rise to two distinctly different mutants, one of which is designated as pyr-5, and the other, laggard (lg), a pseudoallele to pyr-1 (263). In a cross between KS-12 and KS-43 (a pseudoallele of pyr-3), from one ascus, ascospore pair 3–4 was lg. Mutant lg is physiologically similar and pseudoallelic to pyr-1 (showing 0.53% wild-types). Pyr-1 and lg grow slightly in minimal medium and are stimulated by uridine, uracil, dihydrouracil and orotic acid; pyr-1 responds to β-ureidopropionic acid, but lg does not. From the same ascus (KS-12 × KS-43), ascospore pair 7–8, when crossed to wild-type, gave rise to pyr-5. Pyr-5 is physiologically similar to lg except that it does not grow at all in minimal medium; it responds to the same, but not to different, metabolites. Mutant pyr-5 appears to be located distal to pyr-3. Its physiological requirements lead us to conclude that its mutant effects involve the reaction β-UPA $\leftrightarrow$ DHU in the uracil reductive pathway. Mutants involving metabolic interruptions of several steps in the reductive pathway of uracil metabolism as well as the pathway of orotic acid biosynthesis have been studied. The over-all metabolic-genetic scheme will be presented. (This research was supported by a grant from the National Institutes of Health, RG-4561 (C2) Contribution No. 616, Dept. Agron., Kansas Ag. Expt. Sta.)

WRIGHT, JAMES E., and KEEN BUSS. Barriers to Artificial Hybridization of Certain Species of the Salmonidae. *Pennsylvania State University* and *Pennsylvania Fish Commission, University Park, Pa., U.S.A.*

Although certain trout species occupy the same bodies of water and although their spawning periods overlap, natural species hybrids are extremely rare. Recent attempts to artificially hybridize these species for special-purpose hatchery production fish and in order to transfer traits from one species to another by backcrossing revealed a number of isolating mechanisms which limit or prevent hybridization.

The trout species involved, with their somatic chromosome numbers, were: lake trout, *Salvelinus namaycush*, 84; brook trout, *Salvelinus fontinalis*, 84; brown trout, *Salmo trutta*, 80; and rainbow trout, *Salmo gairdneri*, 60. Reciprocal matings between these species were made using several representative males and females from each.

Length of the incubation period of the eggs of the parent species was directly related to hatchability. The incubation period of rainbow trout eggs is approximately 10 days shorter than that of eggs of the other 3 species. When eggs of the latter were fertilized by sperm from rainbows, embryos formed and reached the eyed stage but never hatched. When eggs of the rainbow were fertilized with sperm from any of the other 3 species, some hatchability occurred but the newly hatched alevins appeared very immature and almost all soon died.

Egg size plays an important part in the condition and the survival of sac fry. For example, matings of brook trout females with lake trout males result in progeny extremely crippled in the caudal region. In other matings crippling occurred in the notochord in the dorsal fin region.

Inability to absorb the yolk sac resulted in severe losses in alevins of brown female × brook male, and of rainbow female × brook male crosses. Non-pathogenic white-sac and blue-sac conditions developed in the sac fry.

Hybrids from lake trout female × brook trout males are relatively highly fertile. In the few hybrids that reach maturity from other crosses limited gonad development leads to very high degrees of sterility.

WRIGHT, THEODORE R. F. The Phenogenetics of the Embryonic Lethal, *l*(1)48j, in *Drosophila melanogaster. Yale University, New Haven, Conn., U.S.A.*

The recessive embryonic lethal, *l*(1)48j, is located at 27.7 ± 0.2 on the X chromosome. Lethal hemizygotes never hatch and invariably show two characteristic abnormalities. The most obvious is a mid-dorsal herniation through the hypoderm which includes variable amounts of brain and/or mid-gut. The hypoderm bordering the extruded material becomes heavily chitinized. All of the musculature of the embryo, somatic, visceral, and pharyngeal, is abnormal. Instead of the typical long, slender muscles of the normal embryo one finds large spheroid masses with tremendous increases in volume. This muscular enlargement is so great that the hemocoel is almost completely obscured. These muscles do contract, but do not do any effective work. Although the muscles are still attached to the hypoderm by fine processes there is no muscle tone because of the increased size. No peristalsis has been observed. All other tissues and organs are normal except the mid-gut. Abnormalitites of the morphology of the mid-gut are variable and are dependent on the amount of mid-gut extruded in the herniation.

Lethal embryos are indistinguishable from normals up to 14 hours of development (25°C). Myogenesis proceeds normally and dorsal closure is completed. Between 14 and 14.5 hours the lethal embryos split open along the dorsal mid-line and brain and/or mid-gut is extruded. At the same time the first changes in muscle size and shape are seen. The muscles start to take on the spherical shape by a gradual enlargement of the middle portion of muscle while the ends toward the apodemes begin to thin out. The muscles rapidly become spheroid and continue to increase in size until the death of the embryo.

Histochemical stains for DNA, RNA, carbohydrates, lipids, and proteins do not reveal any qualitative differences between normal and abnormal muscles. Implantation of abnormal embryos into third instar larvae shows that growth and differentiation can continue and that the lethal is physiologically capable of molting. (This investigation was supported by a Predoctoral Fellowship, CF–6730, from the National Cancer Institute, Public Health Service.)

WYLIE, ANN P., and A. J. S. DAVIES. Giant Chromosomes and Amitosis in the Endosperm of *Lathyrus. Department of Botany, University of Manchester, England.*

The development of embryo (including the coenocytic middle-piece and suspensor cells) and endosperm in *Lathyrus* can be followed from two to three days after fertilization onwards, by dissection of intact embryo sacs from ovules stained with the Feulgen reagent. The curved cytoplasmic sac containing the endosperm nuclei can be opened and spread into a single sheet, yielding preparations suitable for detailed cytological study. In the normal course of development, the nuclei in the chalazal region of the endosperm undergo endomitotic growth and attain very high levels of ploidy. Such polyploid nuclei can subsequently divide by normal mitosis and also by an amitotic process, in which their chromosomes are partitioned approximately equally between the two daughter nuclei. These daughter nuclei also can subsequently undergo a normal mitotic cycle. Their origin is revealed by their varying chromosome numbers and by the presence of small acentric rod and ring chromosome fragments, derived from chromosome breakage during the amitotic process. Micronuclei are generally common in regions of endosperm where amitosis has occurred at an earlier stage in development.

Giant polytene chromosomes also arise in the chalazal nuclei, from about 14 days after fertilization onwards. Nuclei with giant chromosomes may undergo amitosis but not a normal mitosis. The regularity with which giant chromosomes occur varies from species to species, depending probably on their heterochromatin content.

Preliminary examination of some other members of the Papilionaceae indicates that the situation found in *Lathyrus* is widespread in the family.

In some interspecific crosses in *Lathyrus* where the embryos abort before reaching maturity, various aberrations of endosperm development occur. These aberrations frequently involve failure of differentiation of the chalazal region of the endosperm. In other cases, endosperm development appears quite normal, and the primary cause of failure resides in the embryo itself.

YAMADA, YOSHIRO. Heredity in Congenital Deafmutism and Hereditary Inner Ear Deafness. *Tokyo Metropolitan Police Hospital, Tokyo, Japan.*

It is known that the three outstanding hereditary diseases in the otological field are congenital deafmutism, hereditary inner ear deafness and otosclerosis. However, in Japan, otosclerosis is seldom seen. This subject has been of particular interest to me for a long time and resulted in a study of forty families.

The first few cases of those I am presenting are of congenital deafmutism caused by consanguinity.

In Family I congenital deafmutism was found in 6 of the 7 siblings. Such a high frequency is rarely seen. It is interesting to note that of the 6 siblings 3 had other neuro-psychiatric diseases, such as epilepsy, depression, and insanity. Family II presented 3 cases of congenital deafmutism. The fact that both husband and wife had perfectly normal children by their previous marriages is worth mentioning.

Family III with 4 siblings included triplets all of whom had congenital deafmutism. From the point of view of heredity it is not necessary to state that all three families had recessive transmissions.

Families IV, V, and VI represent hereditary inner ear deafness. Family IV presented a typical case not only manifesting itself in four generations in succession but appearing in many instances in every generation. The degree of deafness in these cases was from slight to complete. Family V also consanguineous revealed that out of 7 siblings 5 had inner ear deafness varying in degrees. In Family VI the parents were aunt and nephew, though such a marriage is not legal. Of the 7 children, 2 died at an early age, 1 was a deafmute, 2 had labyrinthine deafness, retinitis pigmentosa and coloboma iridis, and 2 were normally healthy.

From this it may be possible to conclude that hereditary labyrinthine deafness has two transmission types, a dominant and a recessive often complicated with other ophthalmological or neurological defects. In the last two families mentioned the sclera were blue which seemed to be of a dominant transmission since they were seen in 3 to 4 generations simultaneously, accompanied by inner ear deafness and osteopsathyrosis.

Yamamoto, Toki-o. Progenies of Induced Sex-Reversal Females Mated with Sex-Reversal Males in the Medaka, *Oryzias latipes. Biological Institute, Faculty of Science, Nagoya University, Chikusa, Japan.*

Success in inducing functional sex-reversal in both genetic males(XY) and females(XX) of the medaka (or killifish) under the influence of heterotypic hormones rendered it possible to mate sex-reversals with sex-reversals. The sex-linked *r*(white) and *R*(orange-red) genes were used as markers for the sex-chromosomes, using as material offspring of white females(X^rX^r) mated with heterozogous orange-red males(X^rY^R) which display the father-to-son inheritance. Induction of sex-reversal in genetic males was made under the influence of estrone and in genetic females by administration of methyl testosterone. Besides matings between sex-reversals(4), the following three kinds of matings served as controls: (1) crosses of normal X^rX^r females with sex-reversal males(X^rX^r); (2) matings of sex-reversal females(X^rY^R) with normal X^rY^r males and (3) matings of normal X^rX^r females by both X^rY^r and X^rY^R males. Eight crosses of (1) yielded all female progenies. Five matings of (2) resulted in offspring in agreement with the expectancy of 1 *r*♀ : 1*r*♂ : 2*R*♂♂, indicating that Y^RY^r males are by no means rare. This fact is in strong contrast to the rarity of Y^RY^R males. Three matings of (3) produced offspring of the two sexes in equal numbers. Three matings(4) of sex-reversal females(X^rY^R) by sex-reversal males(X^rX^r) resulted in 309 *r*♀♀ and 302 *R*♂♂ with 5 exceptional *r*♂♂ and 9 exceptional *R*♀♀. Two exceptional *r*♂♂ and three exceptional *R*♀♀, successfully tested, proved to be crossovers. Crossing-over between the X^r and Y^R does take place in induced sex-reversal females with the heterogametic constitution X^rY^R. The crossover value in X^rY^R females is found to be significantly higher than in normal X^rY^R males.

Yamasaki, Yoshito, and Masahito Kikuchi. Embryo Transplanting as a Method of Genetico-physiological Study in Cereals. *National Institute of Agricultural Sciences, Hiratsuka, Kanagawa, Japan.*

Since 1932 an embryo transplanting experiment has been conducted with mature seeds of cereals (wheat, barley, rye, maize and rice). In 1951 a new technique was developed by which an immature embryo in the course of its development is transplanted into an immature endosperm in order to carry out a genetico-physiological study of the influence of the endosperm on the expression of characteristics of the transplanted embryo.

An endosperm of non-dormant or after-ripened seeds has the ability to promote the germination of an embryo of dormant or intermediate seeds transplanted into the former, but an endosperm of dormant seeds does not always inhibit the germination of the embryo of non-dormant, after-ripened, or intermediate seeds. From these facts the following hypothesis was suggested. The embryo and the endosperm of dormant seeds contain a large amount of germination-inhibiting substances, and little or no germination-promoting substances, while the embryo and the endosperm of non-dormant seeds contain a large amount of the promoting substances, and little or none of the inhibiting substances. Intermediate seeds contain the two kinds of substances in various ratios according to the degree of dormancy. The inhibiting substances may be converted into the promoting substances by treatment with low temperature and oxygen, and by after-ripening.

An endosperm of a spring variety transplanted to an embryo of winter variety does not exert any influence on the flowering behaviour. The same is true of the reverse transplantation. An excised embryo of winter variety did not produce an ear when treated by low temperature before its transplanting to an endosperm, but when treated after its transplanting it produced an ear even when the endosperm of spring or winter varieties, or the endosperm of different species (Einkorn and Emmer wheat) and genera (barley, rice and maize) were used. The supply of some substances (perhaps carbohydrates) from an endosperm during low temperature treatment seems to be necessary to flower formation of an embryo of a winter variety.

Although it is not yet clear what changes do occur at the growing point of the embryo thus treated, the authors suppose that there may be changes in the enzyme systems, induced by the low temperature treatment, due to the presence of carbohydrate, oxygen etc.

YAMASHITA, K. *See* KIHARA, H.

YAMASHITA, KOSUKE, and EN WILLWEBER. Studies on X-Ray Induced Mutations in Einkorn Wheats. *Biological Laboratory, Kyoto University, Kyoto, Japan.*

Dormant seeds of *Triticum aegilopoides* and *T. monococcum* were treated by X-ray, and a number of morphological and physiological mutations were obtained. Those materials have been submitted to cytological and genetic investigations and the data will be presented.

YARNELL, S. H. Penetrance and Expressivity of Six Characters of Cabbage. *U.S. Southeastern Vegetable Breeding Laboratory, Charleston, S.C., U.S.A.*

Terminal Notch is limited to one or a few leaves per plant. Maximum percentage of Notch plants in inbred lines was 2.7 (1955) to 20.5 (1950). Four commercial varieties produced 1.8 to 3.7% Notch (1956) while selected Notch from two varieties produced 3.7 and 4.5%. Selection increases the proportion of Notch, but penetrance and expressivity are low. Populations segregating Notch frequently produce Heterophyllus, a very irregularly shaped leaf. Maximum percentage of Heterophyllus ranged from 7.5 (1957) to 34.9 (1953). Heterophyllus is restricted in both penetrance and expressivity but less so than Notch.

The other four characters affect the entire plant. Pseudowhiptail, certain features of which resemble whiptail of cauliflower, develops late, when the inner leaves become misshapen with very coarse serrations, and the plant becomes lopsided. Maximum percentage varied from 17.5 (1954) to 88.1 (1951). Pseudowhiptail families may also produce Poorkin, a small semi-lethal. Poorkin leaves are thick, often long, and sometimes curled. Maximum percentage of Poorkin ranged from 19.3 (1953) to 73.4 (1957).

Balloon Rosette and Flat Rosette are descriptive of these types. Maximum percentage of the former in inbreds ranged from 1.3 (1954) to 96.4 (1952) and of the latter from 5.0 (1952) to 94.8 (1957).

Environmental conditions may affect the proportions of these six types each season, but expressivity remains unaffected. Environmental effect is gauged by the seasonal range of maximum penetrance of each character. Replicates grown in different years remain essentially unchanged when proportions are less than 10%. For larger amounts the proportion of Heterophyllus decreases with age of seed, and Pseudowhiptail and Poorkin increase. Balloon Rosette and Flat Rosette remain about the same or decline slightly to extensively in subsequent plantings. While selection does not always have the expected effect, the largest proportions of any type usually result from selection.

YASUZUMI, GONPACHIRO. A Study on Spermatogenesis in Animals with the Electron Microscope. *Laboratory for Electron Microscope Research, Department of Anatomy, Nara Medical College, Kashihara, Japan.*

The submicroscopic structure of such maturing spermatids as *Gelastorrhinus bicolor* de Haan, *Cipangopaludina malleata,* and *Eriocheir japonicus* de Haan has been studied in thin tissue sections by electron microscopy. As development proceeds, the nuclei of the spermatids undergo greater changes which affect both their forms and their internal fine structure. These investigations showed a regular arrangement of nuclear contents at an early stage of development and pronounced alteration of the arrangement during maturation. On the basis of evidence afforded by an electron microscopic examination as well as by cytological analysis, the atypical spermatozoa of *Cipangopaludina malleata* are to be interpreted as the olygopyrene or the apyrene.

The submicroscopic structure of mitochondria and the structural changes leading to the formation and evolution of the "nebenkern" of the spermatids have been observed in a grasshopper and a pond snail. The nebenkern derivatives apply themselves to the sheath of the middle-piece in a compact helicoidal fashion.

YERGANIAN, G., D. K. FORD, and T. H. YOSIDA. Survival of Deletions in Cultured (*in vivo* and *in vitro*) Normal and Malignant Cells of the Chinese Hamster, *Cricetulus griseus. Children's Cancer Research Foundation, Harvard Medical School, Boston, Mass., U.S.A.*, and *British Columbia Medical Research Institute, Vancouver, B.C., Canada.*

Spontaneous deletions, generally classed as lethal aberrations, survive and become incorporated in heteroploid *in vitro* and *in vivo* "normal" and malignant cells. Translocations, pericentric inversions and centromeric fractures forming telocentrics and "half-chromosomes" have arisen from chromosomes I, III, VIII, and XI.

The most aberrant element is the largest metacentric or chromosome I. To date, five new forms have been derived from this chromosome alone. Sites of preferential breakage along the short arm of colchicine-pretreated chromosome I are identical to those formed by chemical mutagens (Livingston and Yerganian, Genetics *41*:652).

The new chromosome type A, resulting from a deletion about one micron from the centromere, appeared in tumor CH-38MC and two strains of the C line of "normal" fibroblast after many cell generations. Type B, involving a deletion of the long arm about 1.7 microns from the centromere, proved to be deleterious to the sublime of CH-38MC in which it arose. Type F appeared in tumor 51sp, a spontaneous adenocarcinoma, and was characterized by an insertion of about 1.5 microns of non-homologous chromatin in the long arm, and a deletion along the short arm some 2 microns from the centromere. Types E and G were noted in tumor 53sp, a spontaneous fibrosarcoma, and involved breaks in the short arm 1.6 and 2.5 microns, respectively, from the centromere. The latter form appeared together with the type A chromosome in a 20-methylcholanthrene treated subline of "normal" fibroblast, during the course of advancing hyperdiploidy.

The persistence of certain deletions reflects alterations in the expected selection against deleterious mutations. Forces that prevail in the classic diploid state are gradually replaced by new factors resulting from continuous culture in defined media and/or genetically appropriate hosts.

YOSIDA, T. H. Chromosomal Alterations in Malignant Cells of the Rat. *National Institute of Genetics, Japan,* and *Children's Cancer Research Foundation, Boston, Mass., U.S.A.*

Normal somatic cells of the rat contain 42 chromosomes, including some rod-, J- and V-shaped elements. On the other hand, the tumor stem cells of the Yoshida sarcoma, MTK-sarcoma II and III and Hirosaki sarcoma contained 40 and 38 chromosomes including two and four large V-shaped elements.

From the karyological analysis of the tumor cells of seven original hepatomas which were induced by administration of azo dye, we found that some hepatomas did not contain a large V-shaped chromosome, while other tumors contained one large V-shaped. On the basis of the karyological analysis of these tumor cells, it is suggested that the large V-shaped chromosomes containing tumor cells originated from the translocation of some non-homologous chromosomes.

Recently we found new tumor cells of the Yoshida sarcoma which contained one large J- and two large V-shaped chromosomes. The large J-element is derived from the translocation of two J-shaped chromosomes. The new tumor cells gradually increased in number, as the transplant generation progressed. At the twentieth transplant generation a new sub-line of the Yoshida sarcoma was established. These studies suggest that tumor cells having new chromosome translocations show a more competitive ability in comparison to that of the original ones.

Present studies with the Chinese hamster may provide information concerning the mode of origin of such chromosomal anomalies.

YOSIDA, T. H. *See* YERGANIAN, G., *et al.*

YUASA, AKIRA, and KENJI FUJII. The Organization of the Nuclear Material in *Spirillum* sp. *Department of Biology, College of General Education, University of Tokyo, Tokyo, Japan.*

A *Spirillum* sp. was isolated from stagnant water and cultured purely in reproducible media.

There are great differences in the morphology of the spirilla in young cultures according to the media used. Young spirilla show zig-zag or spiral structure within the cells when cultured in a peptone medium containing Ca-lactate, but not in a peptone medium without Ca-lactate. Aged cells showed the same morphological characters independent of the medium. This zig-zag or spiral structure shows positive nuclear reaction when stained with Giemsa stain or gentian violet solution. The spiral structure of the cytoplasm is related to the deposition of lipid granules. The nuclear material is present in granular state in young spirilla, having some relation to volutin or metachromatic granules. As the cultures develop, the nuclear material aggregates into longitudinal rods.

During cell division, the nuclear material which seems to exist with metachromatic granules is divided transversely, but the division of the nuclear material does not always synchronize with cell division which is also a transverse constriction and fission.

Cells of *Spirillum* sp. were cut into ultra-thin sections with glass knives following methacrylate-embedding at 50°C. The sections indicated the existence of a cell wall and cytoplasmic membrane. The nuclear material was distributed in the granular state at nuclear sites.

YURA, TAKASHI. Genetic Alteration of Pyrroline-5-carboxylate Reductase in *Neurospora*. *Department of Microbiology, Yale University, New Haven, Conn., U.S.A.*

The pyridine nucleotide dependent enzyme, pyrroline-5-carboxylate reductase, catalyzes the terminal step in the biosynthesis of proline in *Neurospora crassa*: the reduction of Δ^1-pyrroline-5-carboxylate to form proline. A proline-requiring mutant of *N. crassa*, strain 21863, is genetically blocked in this step of proline formation and shows a greatly diminished activity of the reductase. Therefore, a comparative study of the pyrroline-5-carboxylate reductase formed by the proline-requiring strain 21863 and of the reductase of several wild-type strains of *N. crassa* has been carried out. Using partially purified enzyme preparations, it was found that the reductase of the mutant strain has an activation energy three to four times greater than that of the wild-type strains. Furthermore, a significant difference was found between mutant and wild-type reductase preparations with respect to stability to heat (40°–60°C). The reductase of the mutant is more labile than that of the wild-type strains, the activation energy for heat inactivation being several times greater with wild-type strains. These differences which have been observed in activation energy and in heat stability appear to be associated with the characteristics of the proline locus (*prol-1*) and may well reflect differences between the formed enzymes since appropriate mixture experiments failed to show interaction between the enzyme preparations from the two sources. The reductase preparations from the mutant and wild-type strains are similar in other respects including stoichiometry, relative activity with the two pyridine nucleotides (TPNH and DPNH), substrate affinity, pH optimum, and in fractionation behavior. The implication of these findings to the problem of gene action will be discussed.

ZABAVI, A. *See* WAHRMAN, J.

ZALOKAR, MARKO. Primary Gene Product: Protein or RNA? *Department of Microbiology, Yale University, New Haven, Conn., U.S.A.*

Enzyme formation is under genetic control. DNA, an essential genetic component, is thought to carry information regarding enzyme synthesis. It is not known, however, whether genes can serve directly as sites of enzyme formation, or whether genes act in protein synthesis through an intermediary such as RNA, this latter substance being suggested by the fact that RNA and protein synthesis appear to be interrelated. Knowledge of the sites of formation of protein and RNA might thus shed a good deal of light on the problem of the primary action of genetic material. Evidence bearing on this problem has been obtained through the development of a technique which permits the centrifugation of living hyphae of *Neurospora crassa.* By this technique it is possible to stratify and separate microsomes, mitochondria and nuclei. Prior to centrifugation, mycelium was fed a radioactive amino acid (C^{14} proline or tritiated leucine) for short periods of time (1–16 minutes). The mycelium was then centrifuged, fixed, and the unincorporated precursors dissolved in cold trichloracetic acid. Autoradiographs were then made. The site of uptake of the amino acid was then determined by counting β-tracks emanating from the diverse particulate fractions. In a similar way the uptake of nucleotides (C^{14} and tritiated uridine) was studied. Results obtained to the present time tentatively suggest that in *Neurospora* proteins are formed mainly in microsomes, while ribonucleic acid appears first in the nuclei and then migrates into the microsomes. The implication of these results will be discussed in relation to the problem of gene action.

ZARUBAILO, T. Y. Transforming Spring Strains of Soft Wheat (*Triticum aestivum* L.) into Winter Strains by Means of Pre-Winter Sowing. *All-Union Institute of Animal Breeding, Moscow, U.S.S.R.*

From 1947 to 1956, experiments aimed at obtaining winter strains of wheat from spring varieties by means of pre-winter sowing were carried out in the town of Pushkin near Leningrad. In these experiments the progeny of individual plants belonging to 30 strains of soft spring wheat (*Triticum aestivum*) were used after checking for homogeneity (pure lines). Part of the seeds of each progeny (line) was annually sown from generation to generation in the pre-winter period (early October), while the remaining seeds were sown in spring for control. By the beginning of winter, the seeds sown in the pre-winter period had time to yield young sprouts.

Out of the 30 strains taken for the experiment, 8 proved to be unsuitable, while the remaining 22, sown in the pre-winter period, were checked to the seventh and ninth generations. All these varieties yielded winter strains of wheat, and in part of them changes of their morphological characteristics were observed. The control seeds of these varieties were sown in spring and steadily preserved their homogeneity both in morphological characteristics and in the length of the vegetation period.

In the course of the first three or four generations sown in the pre-winter period, no considerable increase in the frost resistance of the experimental plants was observed. It remained at an average level of about 10%. It is only in the fourth or fifth generation that the degree of hardiness considerably increased, reaching an average of 40 to 50%. This shows that the increase in the hardiness of the experimental plants took place in the course of the experiment.

In the frost-resistant strains thus obtained, genuine winter wheat characteristics are weakly expressed. When sown in spring, these plants form ears without any vernalization at all, with a slight delay in comparison to the control plants ("double purpose type"), or do so after a comparatively short period of pre-sowing vernalization (which lasted about 25 days in our experiments). At the same time, they require a much longer day (prolongation of the light stage). Genuine winter wheat characteristics (with a long stage of vernalization) only develop in these strains when their seeds are sown at earlier dates, closer to the term when winter wheat varieties are generally sown in the given region. In our experiments this result was obtained when sowing was carried out in early September.

The winter strains of wheat obtained from spring varieties differ from the initial varieties in their increased capacity for accumulating soluble carbohydrates in their cell fluid during the autumn period. They accumulate these substances in the same quantities as those observed in winter wheat (14.18% as against 8.11% in spring varieties). This means that pre-winter sowing brings about certain changes in the biochemical processes which take place in the cells of the plant. Evidently the modifications in these processes form the basis of the hereditary changes which lead to the development of winter strains from spring varieties.

To convince ourselves that the development of winter strains from spring varieties was not merely the result of accidental spontaneous crosses between the controls and plants belonging to winter varieties, one of the experimental strains of spring wheat (Milturum 321) was placed in conditions of artificial isolation of the ears by enclosing them into cellophane containers. In the fourth generation the progeny of such autumn-sown plants which had been submitted to isolation in the course of three generations showed a high degree of frost resistance (70%). When sown in spring, these seeds yielded 22% of winter plants and 30% of plants of a semi-winter type.

ZELLE, MAX R. Studies of a Large Cell, Radiation Resistant, Possibly Polyploid Strain Derived from *Escherichia coli* B/r. *Cornell University, Ithaca, N.Y., U.S.A.*

Comparative studies of normal and polyploid bacterial strains would provide a more critical approach to elucidation of cytogenetic mechanisms in bacteria and of the role of nuclear damage in bacterial inactivation by radiations. A stable, large cell strain, P6, has been isolated following treatment of *Escherichia coli* 82/r (derived from *E. coli* B/r) with camphor vapors.

P6 has displayed a number of characteristics compatible with the hypothesis that it is a polyploid derivative of its parent 82/r. P6 has approximately three times the dry weight, DNA content and RNA content per cell. Counts of the number of discrete Feulgen-positive nuclear structures suggest that P6 may have 1.5 times as many nuclei per cell as 82/r. If DNA is considered to be exclusively nuclear, this would indicate that P6 is diploid. P6 is significantly more resistant to high energy radiations and whereas 82/r yields typical exponential survival curves, P6 displays sigmoidal inactivation curves. The inactivation kinetics are compatible with either an increased nuclear number or an increase in ploidy.

However, essentially similar induced mutation rates are observed in P6 and 82/r for three different mutation systems, two of which presumably involve mutation from a dominant to recessive alleles. The large cell characteristic, most easily followed by the coarsely granular colony structure, segregates much like any unselected character in genetic crosses. The large cell segregants are radiation-resistant and have sigmoidal survival curves like P6. Critical genetic tests designed to detect heterozygous genotypes have not yet given definitive results but suggest that P6 is not polyploid. Rather, P6 may have undergone a mutation which increases the cell size, radiation resistance and, apparently, nuclear number. This tentative conclusion is supported by evidence that this large-cell mutation occurs spontaneously and at increasing rates after increasing exposures to ultraviolet.

ZELLER, J. H. *See* HETZER, H. O., *et al.*

ZHEBRAK, A. R. Polyploidy in Wheat. *Academy of Science of the Belorussian S.S.R., Moscow, U.S.S.R.*

In the genus *Triticum*, the species *T. monococcum* and *T. timopheevi* are isolated from the others. Hybrids were made between these two species and various other species, and then the chromosome number of the resulting hybrid was doubled by treating the dried seeds or the seedlings with colchicine. Hybrids of the types with 28 chromosomes, such as *T. durum* × *T. timopheevi*, and *T. polonicum* × *T. timopheevi* are sterile, but by doubling their chromosomes they become fertile. The hybrid *T. durum* × *T. polonicum*, also with 28 chromosomes, is normally fertile, and doubling the chromosome number in such a fertile hybrid, decreases its fertility 16 times.

The autopolyploids *T. durum* ($2n = 56$) and *T. timopheevi* ($2n = 56$) have low fertility and produce only 4–5 grains per ear. By crossing these autopolyploids the fertility of the hybrids is sharply increased, and as many as 30 grains per ear are produced. Amphidiploids formed from *T. timopheevi* crossed with all the 28 chromosome species do not segregate into the initial species, and have a low degree of variability, which variability increases when the hybrid is crossed with a third species, especially *T. turgidum* × *T. timopheevi* ($2n = 56$) × *T. vulgare* ($2n = 42$). From the offspring of these hybrids ($2n = 49$) we succeeded in isolating forms beyond the limits of the 3 parent species; primitive wheats and forms corresponding to *T. compactum*, as well as valuable types that according to their productivity and resistance to fungus diseases are higher than the standard kinds of wheat.

By crossing the amphidiploid, *T. vulgare* × *T. timopheevi* ($2n = 70$), with *T. vulgare*, sesquidiploids were formed which are strongly segregating and produce in their offspring new combinations of characters that can be regarded as new forms of species.

ZIELINSKI, QUENTIN. Spontaneous Tetraploidy in Pears, *Pyrus communis* Lim. *Oregon State College, Corvallis, Ore., U.S.A.*

Results are reported on twelve new spontaneous tetraploid pears, *Pyrus communis* Lim., discovered in Oregon. Data are presented on morphology of flower and fruits, chromosome determinations, fertility, breeding behavior and horticultural use.

APPENDIX*

DODSON, EDWARD O., and C. K. YU. Centrifugal Force as a Mutagenic Agent: Preliminary Report. *University of Ottawa, Ottawa, Canada.*

We have begun a study of the effects of centrifugal force upon the chromosomes of barley, alone and in combination with phenol. Preliminary observations upon root-tip mitosis have been made. Forces of less than 2,000 g do not produce detectable effects. When seed was centrifuged for 6 hrs. at 2,000 g, the chromatin was moderately clumped and some segmentation of prophase chromosomes occurred. Germination was 90%. Centrifugation at 2,000 g for 20 hrs. had similar effects upon mitosis, but germination was reduced to 75%. Centrifugation at 25,000 g for 6 hrs. resulted in more marked clumping, extensive segmentation of chromosomes, and some amitosis. Germination was reduced to 30%. The combined effect of phenol treatment and centrifugation is under investigation, but results are not yet available. Also, treated seed has been planted out, so that phenotypic effects can be investigated, but no results are available at this writing. (Supported by NRC of Canada grant A-735.)

GLOUSHTSHENKO, I. E. Some Regularities of Vegetative Hybridization of Plants. *Institute of Genetics, Academy of Sciences of the U.S.S.R., Moscow, U.S.S.R.*

Our experiments of many years as well as the experiments of other research workers of the U.S.S.R. have shown that by means of grafting one can obtain hybrid forms which are similar to those obtained by sexual hybridization.

During recent years analogical results have been obtained by many scientists in different countries (I. Sinoto in Japan, R. Glavinich in Yugoslavia, R. Frankel in the U.S.A., R. Georgieva in Bulgaria and others). P. Sopikoff and H. Koushner (U.S.S.R.), K. Brantanoff and N. Nesteroff (Bulgaria), M. Gashek (Czechoslovakia), J. Benoit, P. Leroy, K. and R. Vendrely (France) and other scientists have demonstrated that vegetative hybridization can also be observed in animal organisms.

On the other hand vegetative hybrids of plants and animals have some peculiarities which distinguish them from sexual hybrids. Some of the main distinctions are as follows. (1) Vegetative hybrids are characterized by heterosis which is transmitted to the subsequent generations. (2) The behavior of dominant and recessive characters of vegetative hybrids is not identical with their behavior in sexual hybridization; thus, for example, plants with recessive characters often produce offspring possessing dominant characters. (3) Mosaic forms which possess heterogeneous cells and tissues, heterogeneous fruits, etc., are encountered more often among vegetative hybrids than among sexual hybrids. Interspecific graftings significantly differ from intraspecific graftings. Interspecific graftings produce changed characters as a rule after the grafting is repeated in the following generations. Among the offspring there is a large amplitude of variation which exceeds the variations observed, the forms initially taken for grafting. The new forms obtained usually do not produce .further variations in the subsequent generations.

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*These abstracts were received too late for inclusion in the alphabetical series.

As breeding practice shows vegetative hybridization is a means of creating new forms and of improving old varieties of agricultural plants. Vegetative hybridization experiments show that the characters of organisms can be inherited not only through the nuclei, but in many other ways as well.

LUBIMOVA, VERA FYODOROVNA. On the Origin and Inheritance of Certain New Characters in Wheat-Couchgrass Hybrids. *Main Botanical Garden of the Academy of Sciences of the USSR, Moscow, U.S.S.R.*

(1) In remote hybridizations, besides the hybrids in which the characters of the parental plants are combined, new forms appear with teratological changes and new formations which neither of the parents possessed.

(2) In working with wheat-couchgrass hybrids the following results were observed: (*a*) plants appeared in which the stamens were to some degree transformed into pistils (stamen-pistils); (*b*) multiple-pistil flowers developed possessing all three normally developed stamens but with 2–3 or more additional pistils; (*c*) after fertilization the additional pistils developed into grains. In some of the additional pistils there were two and sometimes three ovules instead of one and double embryo sacs from which twins developed.

(3) In crossing plants which possess multiple-pistil flowers with ordinary plants offspring often appear with stamen-pistils instead of stamens. These plants give rise to multiple-pistil flowers and also to forms that manifest a tendency towards polyembryony. (4) The property of forming multiple-pistil flowers and other new formations is transmitted as a recessive character. (5) The systematic selection of certain new formations makes it possible to fix and obtain constant forms bearing these characters.

(6) Abundance of nutritive substances, a short day, and moderate temperature during the initial development and differentiation of the ears lead to the fuller manifestation of these characters.

(7) A study of the origin and inheritance of the new formations gives a better understanding of the problems of phylogeny and speciation and also makes it possible to create new forms with useful properties.

OLENOV, J. M. On the Increase of Resistance to the Action of Insecticides. *Leningrad, U.S.S.R.*

The possibilities of increasing the resistance to the action of DDT have been studied on five populations of *Drosophila melanogaster*, two of them not having come into contact with DDT before. In the latter populations subthreshold doses during 30 generations had no effect, and selection by propagating the insects which did not come into contact with poison increased the resistance more than a hundred times during 17 generations. These results show the inapplicability of the theory of direct adaptation as an explanation of the resistance of populations.

The average resistance of the populations which have undergone many years of action of DDT is hardly changed as a result of the continuous influx of immigrants, but by means of individual selection we managed to increase it sharply during 4–6 generations. Thus the activity of natural selection preceding the experiment is shown.

The resistance in all lines proved to be polygenically caused (and in one case the maternal effect was found). This is partly explained by the physiological complexity of the character in question. At the same time the effectiveness of the selection illustrates the great hereditary heterogeneity of natural populations.

F_1 crossings between the resistant and sensitive lines resemble resistant parents. Thus, this part of the mutant genes' action spectre does not undergo negative selection in nature.

The highest resistance exceeding 500–1,000 times the level of sensitive lines was obtained in hybrid at the interlinear crossing of stable individuals.

The long-lasting preservation of resistance in natural populations after the causative factor has been removed may be satisfactorily interpreted in the following way. Simultaneously with the increase of resistance in nature (but not with laboratory selection under inbreeding conditions) a selection tending to an increase in the general viability of resistant individuals takes place. The final result is the formation of highly viable populations preserving their characters after the removal of the causative agent. The possibility of getting such a result depends on the degree of isolation characteristic of the given species.

POLYAKOV, I. M. Experimental Study of Fertilization Selectivity in Plants and Some Problems of General Genetics. *Ukrainian Academy of Science, Ukrainian Institute of Plant Breeding, Selection and Genetics, Kiev, U.S.S.R.*

With the advent of new experimental methods proof has been obtained that the fertilization process is selective and we are now able to understand its physiological basis and to investigate certain established laws and regularities in the selectivity of fertilization. The experimental studies carried out by Polyakov and Mikhailova with various species of *Nicotiana* make it possible to differentiate the selectivity which is observed in the progamic phase of the fertilization process, and in the phase of genesis. A number of processes taking place in the progamic phase are also experimentally differentiated. They include: (*a*) the interaction of the pollen with the tissues of the pistil which take a different form in the various parts of the pistil; (*b*) the interaction between the components of the pollen mixture, taking place in the tissues of the pistil.

The phenomena of incompatibility observed in some intraspecific and interspecific crossings represent the same fertilization selectivity expressed in a more marked degree and yield important experimental material for the differential analysis of the phenomenon as a whole. The totality of experimental data indicates the impossibility of reducing the causes of selective fertilization to the unequal competitive capacity of the pollen tubes. The new physiological and biochemical data obtained on the fertilization process in flowering plants are helpful in finding the right approach to the understanding of the physiological basis of selectivity in fertilization.

In conformity with certain internal and external factors, certain laws governing the processes of selectivity in fertilization can be established: (*a*) dependence of the direction taken by selectivity in fertilization on the quantitative relations of the various components present in the mixture of pollen and their proportions; (*b*) dependence of the selectivity of fertilization on the age factor: (*c*) dependence of the selectivity in fertilization on the alimentation conditions of plants, etc. The knowledge of laws governing selectivity in fertilization opens up a possibility for using them in plant-breeding practice.

The general trend of selectivity processes in fertilization expresses the principle of historic affinity in sexual reproduction. Certain stages of intraspecific and interspecific differentiation are reflected to a greater or lesser degree in the selectivity of fertilization. In self- and cross-pollinated plants, fertilization selectivity has certain specific features. In the course of generations, such plants may undergo certain changes of attitude with regard to alien pollen and that of the plant itself (which is equivalent to a change in the direction of fertilization selectivity). Heterosis and fertilization selectivity are connected, and the teleological interpretation of this problem is inadmissible. In each specific crossing the combination of male and female gametes is not determined by chance, but by combined physiological, biochemical, anatomical and cytological factors. The general direction in which these factors exercise their influence is historically determined. It also displays dependences on internal and external factors, sometimes governed by definite laws.

RAJAN, S. S. The Evolution of Yellow Sarson, *Brassica campestris* var. *sarson*: A Self-compatible Race in a Self-incompatible Group. *Division of Botany, Indian Agricultural Research Institute, New Delhi, India.*

The mating system in all the ten chromosome species of the genus *Brassica* is controlled by self-incompatibility alleles. An exception to this is one of the cultivated races, yellow *sarson*, of the *campestris* group. This important Indian oilseed crop is not only self-compatible but also predominantly self-pollinated. Cytogenetic, linkage and self-incompatibility studies made from crosses between the self-compatible yellow *sarson* and self-incompatible *toria* and brown *sarson*, all of the *campestris* group, have rendered possible the formulation of a hypothesis regarding the evolution of the self-compatible race. Cytogenetic studies reveal that the differences between yellow *sarson* and *toria* are of the nature of chromosomal inversion. Genetic analysis of five characters closely associated with the mode of pollination indicates that four of these characters are controlled by genes showing two-factor interaction of the complementary type. Characters favouring self-pollination were recessive in three and dominant in two cases. Linkage studies showed all these five characters to be located on the same chromosome with recombination values ranging from 19.4 to 48.2%. Where the character favouring self-pollination was dominant, the phase of linkage was repulsion. Self-incompatibility studies showed that the self-compatible yellow *sarson* was cross-compatible with the self-incompatible *toria* or brown *sarson*, only as the mother parent. This unilateral crossability points the self-compatibility to be of the primary type rather than a secondary compatibility derived from a pre-existing self-incompatibility. But analysis of the filial generations from the crosses showed self-fertility to behave as a simple Mendelian recessive and this leads to the conclusion that the self-compatibility of yellow *sarson* is in a locus independent of the self-incompatibility alleles.

From these observations the evolutionary history of yellow *sarson* could be visualised as follows. A distant dispersal of a few plants of the self-incompatible race from the northern climate (Himalayas) could have been the original source of material. A recessive mutation of a major gene, independent of the self-incompatibility allelic loci but inactivating them, conferred self-fertility on the genotype. Under natural selection genes favouring self-pollination accumulated and became closely linked with the help of a recombination suppressing mechanism like chromosomal inversions.

STANTON, WILFRED ROBERT. The Origin of the Races of Maize in West Africa. *Ministry of Agriculture, Northern Nigeria, Regional Research Station, Samari, Northern Nigeria.*

A number of hypotheses are prevalent concerning the origin and mode of spread of maize in the old world, but few are capable of support from experimental taxonomic study. In most areas waves of secondary introduction and subsequent hybridization have obscured the identity of the earliest type.

A survey of the maize types of West Africa supports the theory of a desert route (via Spain, Venice, Turkey, and Egypt) bringing in the "Early Caribbean" race and a sea route bringing in a second race direct from Brazil to the West African coast. Socio-ethnological factors have tended to preserve these races, particularly the original northern introduction, and it is only recently that extensive introgression has occurred. It is suggested that in areas north of the ninth parallel, maize types may be found which are more closely related to the early Columbian introduction than those of almost any other part of the Old World.

TSITSIN, N. V. The Creation of New Species and Forms of the Cereals by the Method of Distant Hybridization. *Main Botanical Garden of the USSR Academy of Sciences, Moscow, U.S.S.R.*

Distant hybridization is one of the most important factors in natural selection in the organic world. It is a factor in the creation of new varieties and species of plants and also important in the field of cattle breeding. The elaboration of this method gains great economic importance in the enrichment of the flora and fauna in our country and particularly in the development of new regions. One of the areas where this method has been applied has been the crossing of cultivated and native plants. The work on cereal crops has proved particularly fruitful.

Triticum × *Agropyron* using *A. glaucum*, *A. elongatum*, *A. junceum*, *A. trichophorum* and *A. repens* have yielded new species of forage grain and perennial wheat (*Triticum agropyrotriticum perenne*) as well as two varieties of winter wheat *T. vulgare* var. *alboramosum* and *T. vulgare* var. *rubroramosum*. Perennial and grain-forage wheats open up new horizons in the use of wheat not only for grain with a high content of albumin (more than 20%) but at the same time for forage grass or hay with an albumin content equal to that of the grain of common soft wheat. In *Secale* × *Agropyron* a great deal of sterility is encountered in the F_1 generation. With the induction of polyploidy we are able to overcome this sterility and obtain fertile hybrids. Crosses involving *Triticum, Hordeum* and *Secale* with *Elymus arenarius* and *E. giganteus* are difficult to perform. Freeing the embryos from the seed coat and growing them on nutritive media allows for the recovery of F_1 plants. Hybrid plants have been recovered from the following crops: *Triticum* × *E. arenarius, Triticum* × *E. giganteus, Triticum* × *E. niollis, Hordeum* × *E. giganteus, Secale* × *E. arenarius,* (*Triticum* × *Agropyron*) × *E. arenarius* and finally (*Triticum* × *Agropyron*) × *E. giganteus.* Seeds (P_2) were recovered from F_1 plants (*Triticum* × *E. giganteus*) after their treatment with colchicine and with repeated pollinations.

TURBIN, N. V. New Data on the Biology of Fertilization of Seed Plants. *Academy of Science of Belorussian SSR. Minsk, Belorussia, U.S.S.R.*

In the experiments with various varieties of *Triticum vulgare* and *T. durum* it was found that under strict self-pollination (under isolation) a much worse result is obtained than under natural pollination, when the possibility of dusting the flower stigma by pollen of other plants is not excluded (cross-pollination). The percentage of fertilization is lower and the absolute weight of seeds falls in tests under isolation.

The analysis of control data has shown that the above-mentioned difference in fertilization is due to the existence in one of them and the absence in the other of the possibility of additional cross-pollination. Thorough observations on a large number of plants of many wheat varieties have shown that the structure and biology of flowering of wheat favours the effect of additional cross-pollination. The possible frequency of occurrence of cross-pollination may be judged on the basis of the established fact that the quantity of flowers of wheat that are fully open during the whole period of flowering is 60–90% of their total number. By an additional artificial pollination of wheat one observes a positive result, proving the existence of interaction between the pollen of the plant and foreign pollen. Similar data have been obtained in experiments with tomatoes and other self-pollinated plants.

As for rye and partly for other cross-pollinated plants it is ascertained that cross-pollination of emasculated flowers gives a worse result than pollination of non-emasculated plants, when interaction of self and foreign pollen is possible. The essential difference between wheat and rye as regards biology of pollination and fertilization consists in the sharp difference of these plants (wheat and rye) in the degree of their self-fertilization. The above mentioned results are especially striking in tests of inbreeding of plants and the application of additional pollination by heterogeneric pollen. For instance, in rye the setting of seeds increases in such tests by 10–12 times as compared with ordinary inbreeding.

It is established that the effect of heterogeneric co-pollination is observed only when using foreign pollen taken from species related to the mother plants. Positive results may be observed only when heterogeneric pollen germinates on the stigmas of experimental plants. The most probable mechanism of its action consists in the extraction of biologically active substances effecting the germination of pollen of mother species and in some cases strengthening the fertilization capacity of the latter.

WEINSTEIN, ALEXANDER. Did Nägeli Fail to Understand Mendel's Work? *Biological Laboratories, Harvard University, Cambridge, Massachusetts, U.S.A.*

Nägeli, it has been assumed, failed to understand Mendel's work, and finally forgot it when writing his book on heredity and evolution. But before Mendel wrote, Nägeli and other hybridists knew that the progeny of hybrids tend to split into three classes resembling respectively the hybrid parent and the two pure ancestors. Nägeli knew Naudin's work, and had himself discussed segregation, and had proposed a mathematical formula to test the rate of reversion to the pure form when each successive generation is crossed to the same pure ancestor. Nägeli also distinguished between internal qualities and external characters. (See Sitzungsberichte der königlichen bayerischen Akademie der Wissenschaften zu München, 1865, vol. 2, pp. 395–443; 1866, vol. 1, pp. 71–93, 93–127.) These facts may explain why Mendel wrote to Nägeli in the first place.

Nägeli's formula was rendered unnecessary by Mendel's evidence that reversion is complete in F_2. Nägeli objected that (1) Mendel's results might vary with environment, (2) Mendel's ratios were empirical, not rational, (3) heredity in other plants might differ from heredity in peas. Nägeli could have found support for these objections in Mendel's work. (1) Mendel's paper mentions variability in four of the seven segregating characters. (2) Ratios from individual plants, though averaging close to 3:1, varied between 32:1 and 24:13 (less than 2:1). (3) The subsequent failure to find segregation in *Hieracium* caused Mendel himself to admit that to "take rules deduced from observation of [pea] hybrids to be laws of hybridization" might be "erroneous" because "*Hieracium* hybrids show a behavior exactly opposite to those of *Pisum.*" Nägeli's letters and notes show he understood Mendel's theory; for he proposed testing it by breeding extracted homozygotes, and for this purpose asked for the very plants a modern geneticist would have picked. That Nägeli forgot Mendel's pea experiments is unlikely because Nägeli had an unusually good memory; Nägeli's book, though not mentioning Mendel, shows some influence of Mendel's paper; and in a later work Nägeli cited Mendel's *Hieracium* experiments under the title of the paper on peas.

(Supported by a grant from the Commonwealth Fund.)

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